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Unit – 01: Introduction to IOT

- Basics of IoT, concepts of IoT,
- History of IoT, Applications of IoT
- Basic IoT System and its building blocks
- Various platforms for IoT (e.g. AWS, AZURE, GCP)
- Introduction to Python programming

Questions to be discussed:

1. Define the term IoT. What are the application of IoT?
2. Discuss the functions of each block of the Basic IoT system.
3. What is IoT Platform? Explain its type in brief.
4. What is python? Explain the basic features of python programming.
5. Write short notes on:
   a. AWS IoT Platform
   b. GCP IoT Platform
   c. AZURE IoT Platform
   d. Python programming

What is internet?

- It connects millions of computers, webpages, websites, and servers.
- Using the internet we can send emails, photos, videos, messages or many more.
- It creates a communication medium to share and get information online.
- If your device is connected to the Internet then only you will be able to access all the applications, websites, social media apps, and many more services.
- Internet nowadays is considered as the fastest medium for sending & receiving information.

"Things" in IoT

- Things refer to IoT devices with unique identities that have actuating, monitoring, and remote sensing capabilities.
- Things are the primary component of IoT applications.
- IoT devices can be of various types, including smartwatches, sensing devices, smart electronics appliances, automobiles, wearable sensors, and industrial machines.
- IoT devices generate data in some form which leads to useful information when processed.
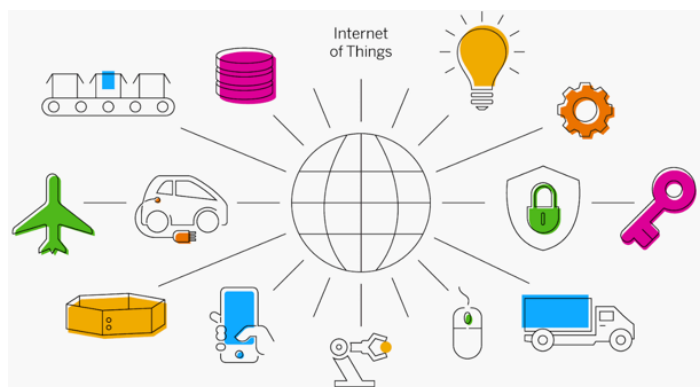
Define the term IOT:

- IOT stands for internet of things.
- The term 'Internet of Things' was introduced in 1999 by the computer scientist Kevin Ashton.
- The IoT denotes the connection of devices, machines, and sensors to the Internet.
- IOT is a world of interconnected things.
- Taking everyday things, embedding them with electronics, software, sensor and then connecting to them with the internet and enabling them to collect and exchange data without human intervention is called internet of things.
- The life cycle of IOT is collect, communicate, analyze and act.
- The IoT refers to the billions of physical devices around the world that are now connected to the internet to collecting and sharing data.

Advantage and disadvantage of IOT :

Advantage :

- Efficient utilization of resources
- Minimum human effort and save time
- Lead to more automation
- Help in improving the technology
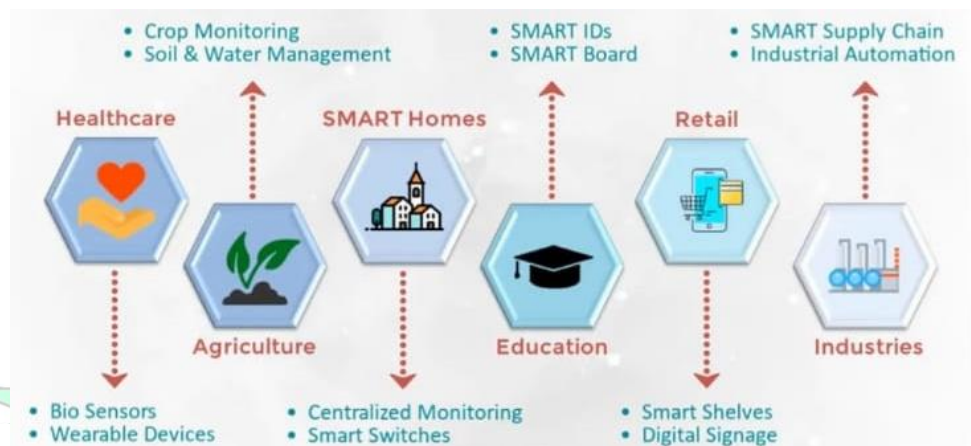- Help us to reduce waste and use our natural resources effectively.
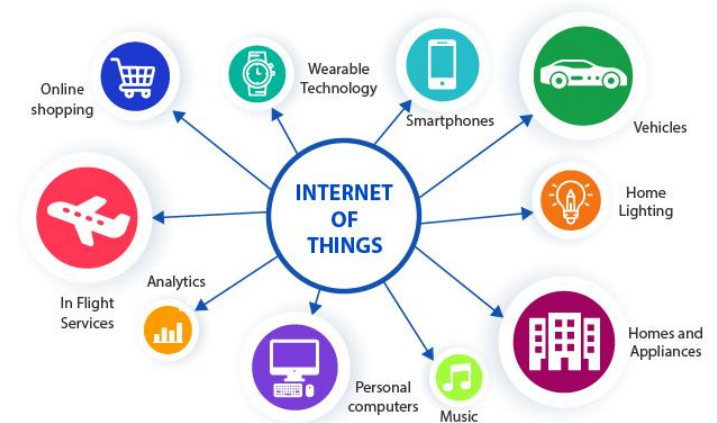
Disadvantage :

- Security of confidential data
- Can lead to various types of network attacks
- Maintaining privacy is a challenge

Application of IOT :

- Healthcare
- Agriculture
- SMART Homes
- Education
- Retail
- Industries
- Smart city application

What are the characteristics of the Internet of Things ?

The following are the major characteristics of the Internet of Things:

1. Connectivity
2. Identity of Things
3. Data
4. Intelligence
5. Network – Communication
6. Scalability
7. Architecture – Common Ecosystem
8. Security

Define the function of each blocks of the basic IoT system :

- The Internet of Things denotes the connection of devices, machines & sensors to the Internet.
- An IoT system comprises four basic building blocks : sensors, processors, gateways, and applications.
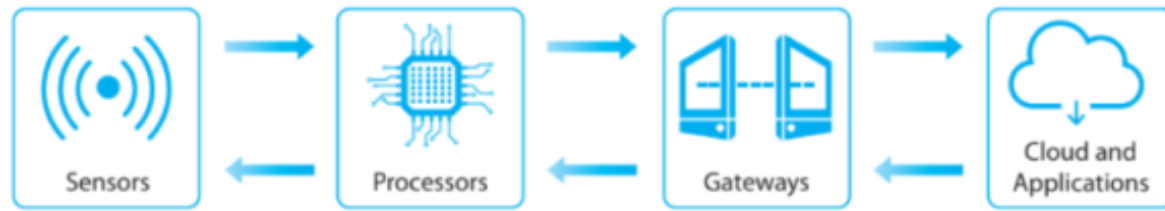
Sensors :

- These form the front end of the IoT devices.
- These are the so-called "Things" of the system.
- Their main purpose is to collect data from its surroundings.
- These have to be uniquely identifiable devices with a unique IP address.
- Sensors are classified into two types: active and passive sensors.
- Active sensors use to collect real-time data (ex.: GPS, X-ray, radars).
- Passive sensors use energy from external sources (ex: cameras).
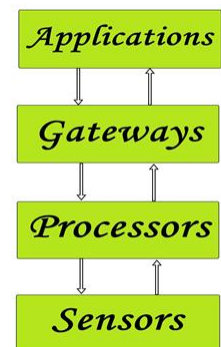
Processors :

- Processors are the brain, the main part of the IoT system.
- They process the raw data captured by the sensors and extract valuable information.
- Examples of processors are microcontrollers and microcomputers.

Gateways

- Gateways are the combination of hardware & software used to connect one network to another.
- It provides network connectivity to the data.
- Network connectivity is essential for any IoT system to communicate.
- LAN, WAN, PAN, etc are examples of network gateways.

Applications:

- It provide a user interface and effective utilization of the data collected.
- Applications are essential for proper utilization of all the data collected.
- Examples of applications are home automation apps, security

What is an IoT Platform?

- An IoT platform is a tool for managing IoT systems.
- It works as a mediator between the world of physical objects and the world of actionable insights.
- IoT Platform connects sensors and devices.
- IoT platform handles different software communication protocol and hardware.
- IoT platform provides security and authentication for sensors and users.
- It collects, visualizes, and analyzes the data gathered by the sensor and device.
- There are several IoT Platforms available that provides facility to deploy IoT application actively:
    1. Amazon AWS IoT Core
    2. Microsoft Azure IoT Hub
    3. Google Cloud IoT Platform
    4. Cisco IoT Cloud Connect
    5. Oracle IoT Platform
    6. Cumulocity IoT Platform
    7. IBM Watson IoT platform etc.

AWS IoT platform:

- AWS stands for Amazon Web Services.
- It offers a set of services that connect to several devices and maintain the security as well.
- This platform collects data from connected devices and performs real-time actions.

Microsoft Azure IoT platform:

- Azure IoT platform offers strong security mechanism and easy integration with systems.
- It uses standard protocols that support bi-directional communication between connected devices and platform.
- It processes a large amount of information in real-time generated by sensors.

Google Cloud Platform(GCP) IoT Platform:

- GCP stands for Google Cloud Platform.
- GCP is a global cloud platform that provides a solution for IoT devices and applications.
- It handles a large amount of data using Cloud IoT Core by connecting various devices.
- It allows to apply Big Query analysis or to apply Machine learning on this data.

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Unit 2: IoT Communication protocols

- Basics of given communication protocol along with its applications
- Explain Communication Protocols
    - MQTT
    - Bluetooth Low Energy
    - ZigBee
    - LoRa
    - Wi-fi

Questions to be discussed:

1. Define IoT communication protocols. Discuss about BLE protocol.
2. Differentiate between Bluetooth and Wi-Fi communication protocols.
3. Write short notes on:
    a. MQTT
    b. ZigBee
    c. LoRa
    d. Wi-Fi
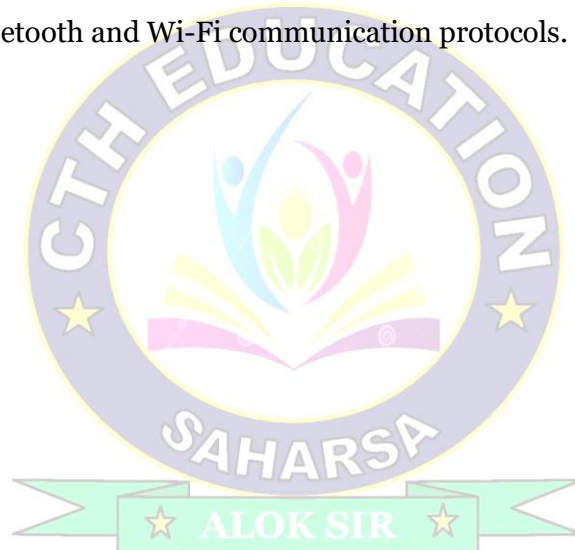
IoT protocols:

- It ensure that how IoT devices communicate among with each other on the network.
- IoT protocol is a set of rules that dictates how data gets sent to the internet.
- IoT protocols ensure that information from one device gets read and understood by another device.
- Several Communication Protocols and Technology used in the internet of Things.
- Some of the major IoT Communication Protocols are:
  - ➢ MQTT
  - ➢ Bluetooth,
 - ➢ Zigbee
  - ➢ LoRa
  - ➢ Wifi etc.
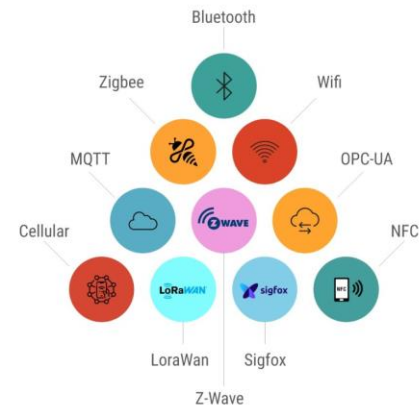
MQTT:

- MQTT stands for **Message Queuing Telemetry Transport**.
- The MQTT protocol was invented in 1999 for use in the oil and gas industry.
- It is a machine to machine IOT connectivity protocol.
- It makes it easy for communication between multiple devices.
- It does not require that both the client and the server establish a connection at the same time.
- This protocol is useful for the connection with the remote location where the bandwidth is a premium.
- It is a publish and subscribe system where we can publish and receive the messages as a client.
- It provides faster data transmission, like how WhatsApp/messenger provides a faster delivery.

Applications of MQTT:

1. Remote sensing
2. Smart cities
3. Social media platforms
4. Home automation
5. Smart farming
6. Wearables
7. Manufacturing
8. Oil and gas industry
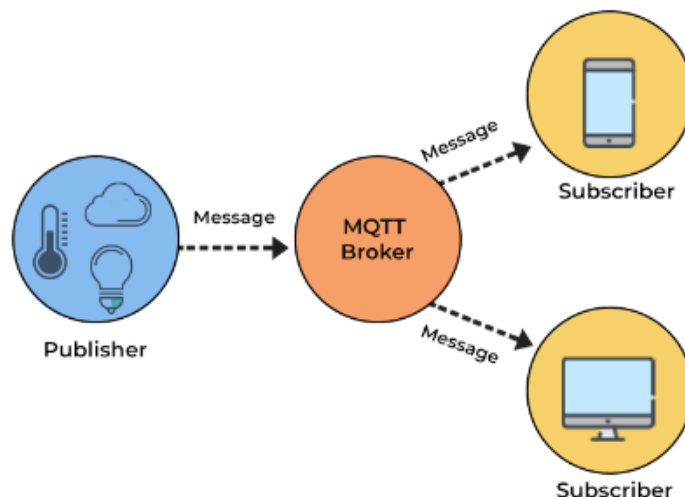
Bluetooth:

- Bluetooth is an important short-range IoT communications Protocols.
- It is also known as Bluetooth Low-Energy (BLE) or Smart Bluetooth.
- The first Bluetooth was developed in the year 1994 by Sven Mattison and Jaap Haartsen.
- They were working in a mobile phone company named Ericsson which is in Sweden.
- Then five companies came forward and joined to form the Bluetooth special interest group.
- Then they developed the Bluetooth protocol specification version 1.0 in the year 1999.
- Up to eight devices can be networked in the Piconet by using Bluetooth.
- Bluetooth offers economic wireless solutions (both data & voice) for short distances.
- It is used in the mobile and stationary environment.

Applications of Bluetooth Protocol:

- Bluetooth hands-free communication
- Car Bluetooth entertainment system
- Technicians' wireless monitoring of CNC machine tools
- Wireless communication with PC's : Mouse, Keyboard, Printer etc.
- Interactive entertainment devices: Gaming controller, Remote contro
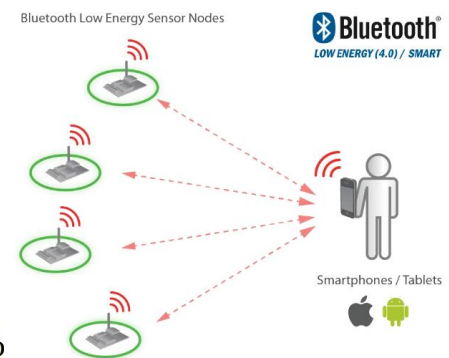
ZigBee:

- ZigBee is most popular wireless communication protocol.
- It defines a set of protocols for use in low data rate, short to medium range wireless networking devices like sensors and control networks.
- The target of Zigbee is low cost, low power & battery operated wireless sensors.
- Zigbee Technology is based on IEEE 802.15.4 Standard.
- The Zigbee protocol defines three types of nodes: coordinators, routers and end devices.
- Although all nodes can send and receive data, they each play a different role.
- There is one coordinator in each network whose job is to store information about the network, including security keys.

Applications of ZigBee:

- Home Automation
  - Security Systems
  - Meter Reading Systems
  - Light Control Systems
- Consumer Electronics
  - Gaming Consoles
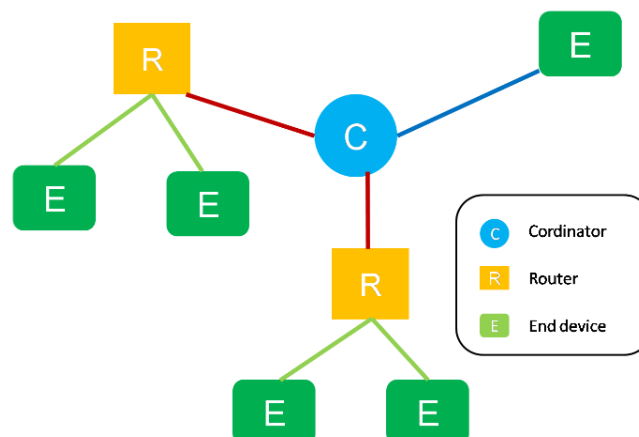
- ✓ Wireless Mouse
- ✓ Wireless Remote Controls
- ➢ Industrial Automation
    - ✓ Asset Management
    - ✓ Personnel Tracking
- ➢ Healthcare
- ➢ Hotel Room Access
- ➢ Fire Extinguishers

Wi-Fi:

- Wi-Fi stands for Wireless Fidelity.
- It is one of the most popular IoT communication protocol.
- It especially given the availability of Wi-Fi within the home environment within LANs.
- It offering fast data transfer and the ability to handle high quantities of data.
- Currently, the most common WiFi standard used in home is 802.11n, which offers range of 100 Mbps, which is fine for file transfers but may be too power-consuming for many IoT applications.

Applications of WiFi Technology:

- ➢ Mobile applications
- ➢ Business applications
- ➢ Home applications
- ➢ Computerized application
- ➢ Automotive segment
- ➢ Browsing internet
- ➢ Video conference
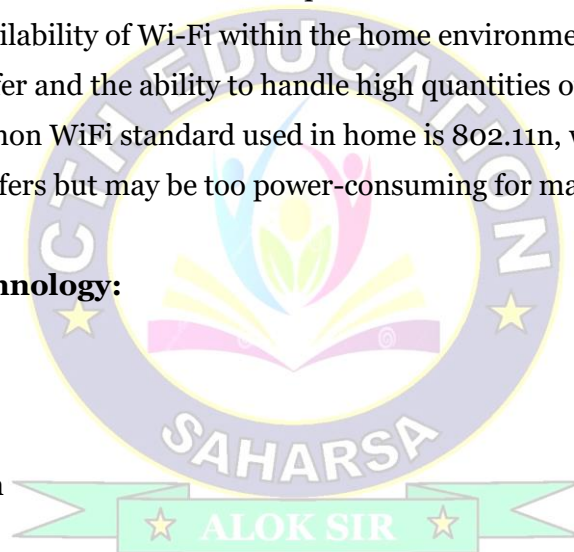
LoRa:

- LoRa is also known as LoRa WAN.
- LoRa WAN is one of popular IoT Technology, targets WAN applications.
- It support low-cost mobile secure communication in IoT, smart city, and industrial applications.
- Specifically meets requirements for low-power consumption and supports large networks with millions of devices, data rates range from 0.3 kbps to 50 kbps.

LoRa Application:

➢ Air Pollution Monitoring

➢ Agriculture Processing

➢ Fire Detection

➢ Home Security

➢ Indoor Air Quality

➢ Industrial Temperature Monitoring

➢ Smart Lighting

➢ Waste Management

➢ Water Flow Monitoring

Differentiate between Wi-Fi and Bluetooth:

Wi-Fi	Bluetooth
Wi-Fi stands for Wireless Fidelity.	Bluetooth has no full form.
Wi-Fi is a technology that enables devices to connect to the Internet wirelessly.	Bluetooth is a wireless technology that is used to connect devices in short range.
Wi-Fi requires wireless adaptor on all devices and Wireless Router for connectivity.	Bluetooth requires an Bluetooth adaptor on all devices for connectivity.
Wi-Fi consumes high power.	Bluetooth consumes less power than Wi-Fi.
Wi-Fi is more secure than Bluetooth.	Bluetooth is less secure than Wi-Fi.
Wi-Fi needs high bandwidth.	Bluetooth has a low bandwidth.
Wi-Fi coverage area is up to 32 meters.	Bluetooth coverage area is about 10 meters.

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Unit-3: Sensors and Hardware for IoT

➢ Sensors and Classifications of sensors,

➢ Actuators, Transducers,

➢ IoT sensor Development Boards and classifications,

➢ Basics of wireless networks,

➢ Wi-Fi libraries

➢ Introduction to node MCU, block diagram.

Questions to be discussed:

1. What do you mean by sensors? Explain different types of sensor in brief.
2. Differentiate between sensor and actuator?
3. What is sensor IOT development board? Discuss its type in brief.
4. Discuss about wireless network. What are advantages of wireless network?
5. Explain in brief about Node MCU. Also write the features of it.
6. Write short notes on:
   a. Actuators
   b. Transducer
   c. Wi-Fi Library
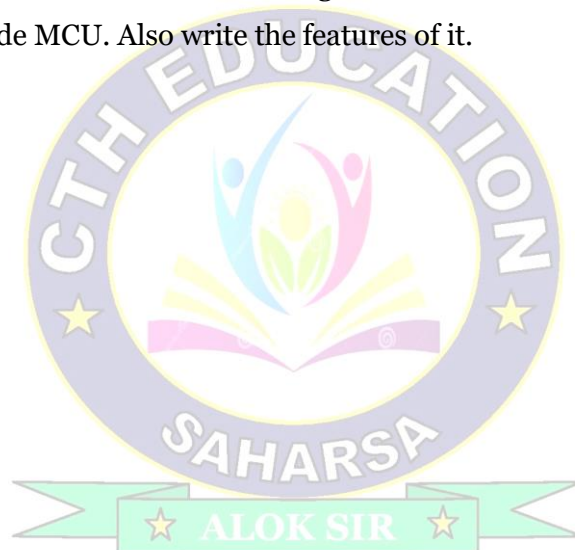
What are sensors?

- Sensors or transducers represent physical devices that convert one form of energy into another.
- Sensors are such devices which are used to convert physical quantities into the electrical signals for the purpose of monitoring and controlling.
- So sensor takes input from environment and converts into electrical form then controller the system.
- Sensor works as an input device.
- Sensors convert a physical device into an electrical impulse to take the desired action.
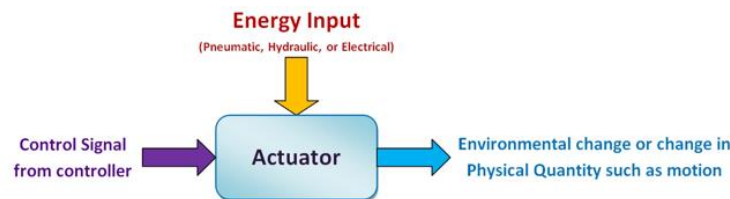- Example: Thermocouple, photo cell, RTD, LVDT, strain gauge, Load cell etc.

Change in its surrounding or environment i.e. Physical Quantity → **Sensor** (With Signal Conditioning Element) → Electrical Output

Types of Sensors:

1. **Temperature**: The temperate sensor records the amount of heat in a given setting.

2. **Moisture**: The moisture sensors record the amount of humidity.

3. **Light**: Light sensors record the ambient light. In your smartphone, when the brightness is adjusted according to the exposure to light.

4. **Motion**: Motion sensors are usually installed in security systems and help detect unauthorized activity.

5. **Proximity**: Motion sensors and proximity sensors can be kept in the same basket, as the majority of their functions are similar.

6. **Gyroscope**: These sensors are used to measure the velocity of a moving object.

Temperature Sensor   Humidity Sensor   Proximity Sensor

Light Sensor   Metal Sensor   Color Sensor
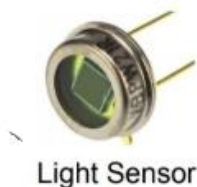
What are Actuators?

- Actuators are such devices which deliver physical quantity (like force or motion) to the environment by converting source energy according to control signal received that can be in electrical form.
- They convert electrical impulses into physical actions or objects.
- In the light example, as the sensor is reading the brightness of the light by converting it into an electrical signal, an actuator takes action according to the desired setting.
- So here, it will decrease or increase the light brightness according to the set parameters.
- Actuator acts as output device.
- Examples: Electric motor actuator, heaters, electro-hydraulic actuator, magnetic actuator etc.

Energy Input
(Pneumatic, Hydraulic, or Electrical)

Control Signal from controller → Actuator → Environmental change or change in Physical Quantity such as motion

Difference between sensor and actuator:

Sensor	Actuator
Sensor converts physical quantities and characteristics into electrical signals.	Actuator converts electrical signals into physical action such as force and motion.
It acts as an input device in any control system.	It acts as an output device in a control system.
Sensor takes input from environment.	Actuator takes input from output signal.
Sensor gives output to input signal conditioning unit of system to convert into electrical form.	It gives output to environment and makes impact on load to control parameters.
It gives information to the system about environment condition to monitor and control.	It accepts command from system to deliver physical action.
Sensors are often used to measure pressure, temperature, fluid levels, vibration, speed etc.	Actuators are often used to operate control valves, dampers, guide vanes, and to move objects from one place to another, to move conveyor belts in robotic arms movement etc.
Examples: Thermocouple, photo cell, RTD, LVDT, strain gauge, Load cell, PH meter etc	Examples: motor actuator, servo motor, heaters, electro-hydraulic actuator, magnetic actuator etc

Sensor
(Measure process variable) → **Controller** (Desicion Making) → **Actuator** (Takes action to control)

- ✓ RTD (Resistance Temperature Detector)
- ✓ LVDT is an acronym for Linear Variable Differential Transformer.

What is a transducer?

- A transducer is an electronic device that converts energy from one form to another for the purpose of measurement and control."
- The process of converting energy from one form to another is known as transduction.
- Examples: microphones, loudspeakers, thermometers, position and pressure sensors, and antenna.
- A photocells, LEDs, and even common light bulbs are transducers.
- Efficiency is an important consideration in any transducer.
- Transducer efficiency is defined as the ratio of the power output to the total power input.
- Mathematically, if P represents the total power input and Q represents the power output then the efficiency E, is given by:

$$E = Q/P$$

Non-electrical quantity → Sensing element — Sensor Response → Transduction element → Electrical signal

What are IoT Development Boards?

- A development board is a printed circuit board with circuitry and hardware.
- An IoT development board includes:
  - A programming interface to program the microcontroller from a computer.
  - A power circuit used to provide stable DC power to the microcontroller.
  - Input components: buttons, switches, etc.
  - Output components such as LEDs.
  - Various I/O pins used for compatibility with sensors, motors, screens, and any other components.

Types of IoT Development Board:

1. Microcontroller
2. System-on-Chip
3. Single Board Computers (SBCs)

Microcontroller:

- Microcontroller based boards, usually built with CMOS processes.
- These are used in implants, office machines, power tools, and automotive control systems.

System-on-Chip(SoC):

- SoC boards have more system components integrated into the chip and memory.
- It has audio receivers, PCI, SATA, and USB communication abilities in addition to a microprocessor.
- They allow for higher processing speeds with less microchip power.

Single Board Computers (SBCs):

- It contains all the features of a computer on a single device, including I/O ports, microprocessors, and memory.
- SBCs are usually larger but are more capable and do not need to rely on expansion slots for additional peripheral capabilities.

Wireless Networks:

- Computer networks that are not connected by cables are called wireless networks.
- They generally use radio waves for communication between the network nodes.
- They allow devices to be connected to the network within the network coverage.

Types of Wireless Networks:

1. **Wireless LANs** – Connects two or more network devices using wireless distribution techniques.
2. **Wireless MANs** – Connects two or more wireless LANs spreading over a metropolitan area.
3. **Wireless WANs** – Connects large areas comprising LANs, MANs and personal networks.

Advantages of Wireless Networks:

- It provides clutter-free desks due to the absence of wires and cables.
- It increases the mobility of network devices connected to the system.
- Accessing network devices from any location within the network coverage.
- Installation and setup of wireless networks are easier.
- New devices can be easily connected to the existing setup.
- Wireless networks require no wires so, it reduces the setup costs.

Examples of wireless networks:

- Mobile phone networks
- Wireless sensor networks
- Satellite communication networks
- Terrestrial microwave networks

Wi-Fi library:

- It enabled boards can use the Wi-Fi library to connect to the internet.
- It can serve as either a server accepting incoming connections or a client making outgoing ones.
- The library supports WEP and WPA2 Personal encryption, but not WPA2 Enterprise.
- The Wi-Fi library is very similar to the Ethernet library, and many of the function calls are the same.

What is Node MCU?

- MCU stands for microcontroller unit.
- Node MCU is an open source IoT platform.
- Most people call **ESP8266** as a **WIFI module**, but it is actually a **microcontroller**.
- ESP8266 is the name of the microcontroller developed by Espressif Systems which is a company.
- This microcontroller has the ability to perform WIFI related activities hence it is widely used as a WIFI module.
- The Node MCU platform is a popular choice for creating IoT projects because of its low cost and the simplicity of its hardware.
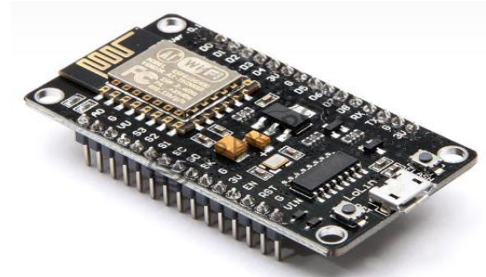
What are the features of Node MCU?

- Node MCU has 128 KB RAM and 4MB of Flash memory to store data and programs.
- Its high processing power with in-built Wi-Fi/Bluetooth features make it ideal for IoT projects.
- It has better processor and memory:
- Node MCu comes with 80MHz clock speed and 4MB flash memory.
- Built-in TCP/IP Stack - IoT Ready:
- Node MCU has Wi-fi connection and can connect to internet via Wi-fi.
- It is best suited for IoT applications.

## ESP8266 Functional Block Diagram

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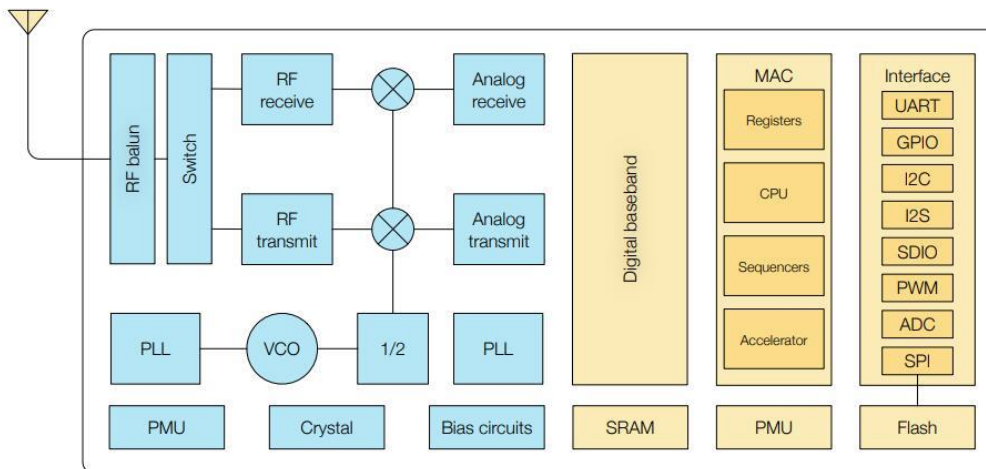
Unit – 04: IoT APIs and its Integration

➢ Explain APIs and its use

➢ Explanation of given IoT APIs along with its applications

➢ REST

➢ SOAP

➢ JSON

➢ MQTT, Broker, subscriber, publisher

➢ Programming API using Python

Questions to be discussed:

1. What do you mean by IoT API? What are the application of API?
2. Explain different types of IoT API.
3. Discuss MQTT Broker subscriber/publisher model.
4. How to create an API using python?
5. Write short notes on:
   a. REST
   b. SOAP
   c. JSON
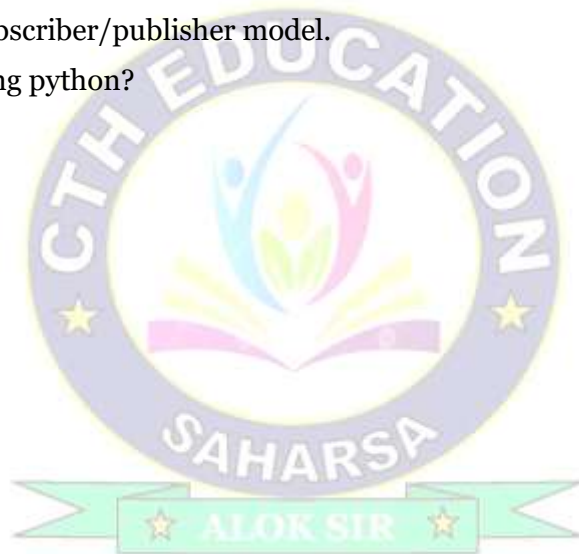
What is an API?

- API stands for Application Programming Interface.
- An API allows two or more IoT devices interact with each other.
- APIs are the points of interaction between an IoT device and the internet within the network.
- It is a set of rules that are shared by a particular service.
- An API acts as a layer between your application and external service.
- You do not need to know the internal structure and features of the service, you just send and receive.
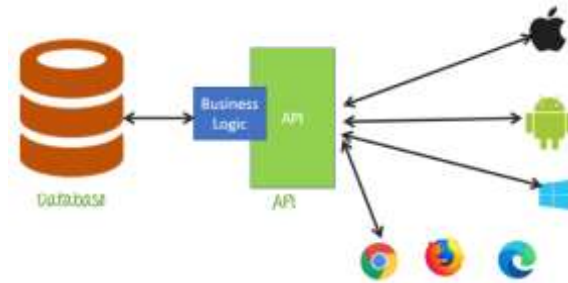
Applications of API:

- Desktop applications.
- Web applications.
- APIs make mobile applications possible.
- APIs connect devices to the internet.
- APIs define the networks or the information passed between applications, systems, and devices.
- Connect everyday things like automobiles, doorbells, dishwashers, and wearable devices.

API Types in IoT:

1. SOAP
2. REST
3. JSON

SOAP

- SOAP stands for Simple Object Access Protocol.
- They make building a communication bridge between the servers and the clients.
- It is much complex but also well defined in terms of security.
- Banking transactions or any other applications that need high security use this API.
- It works over HTTP, HTTPS, SMTP, XMPP.
- Designed with large enterprise applications.

REST:

- REST stands for Representational State Transfer.
- It is a software architecture that defines a pattern for client and server communications over a network.
- REST provides a set of constraints for software architecture to promote performance, scalability, simplicity, and reliability in the system.
- It is one of the most popular web API used.
- The client-server communication is simple here and is based on URL or HTTP protocols.

Differentiating between SOAP API and REST API:

SOAP API	REST API
SOAP stands for Simple Object Access Protocol.	REST stands for Representational State Transfer.
Transports data in standard XML format.	Generally transports data in JSON.
Because it is XML based and relies on SOAP, it works with WSDL	It works with GET, POST, PUT, DELETE
It works over HTTP, HTTPS, SMTP, XMPP	It works over HTTP and HTTPS
Highly structured.	Less structured.
Designed with large enterprise applications.	Designed with mobile devices in mind.

JSON:

- JSON stands for JavaScript Object Notation.
- It has one of the best request efficiency API.
- It uses JSON formatting which is much reliable and simple to use.
- It is human-readable as well as machine-readable and is designed in such a way that they call methods.

MQTT, Broker, subscriber, publisher:

- MQTT stands for Message Queuing Telemetry Transport.
- It is a publish-subscribe architecture that is developed to connect devices over wireless networks.
- It is a simple and lightweight protocol that runs over TCP/IP sockets, WebSockets, and SSL.
- MQTT has two components:
    1. MQTT broker.
    2. MQTT client.
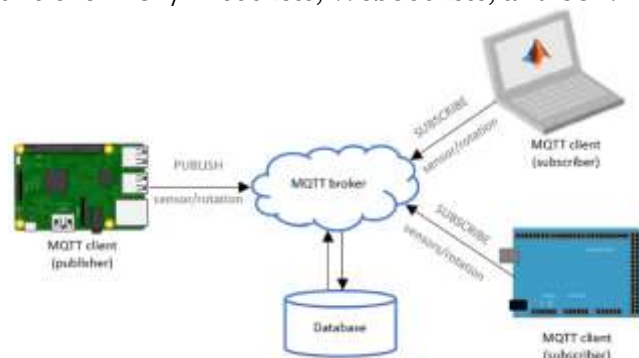
MQTT broker:

- An MQTT broker is a central point of communication.
- The broker is responsible for dispatching all messages between the clients.

MQTT client:

- An MQTT client is any device (computer or a mobile phone) that connects to the broker.
- A client that sends messages is a publisher.
- A client that receives messages is a subscriber.
- To receive a message, the client must subscribe to the topic of that message.
- You can publish and subscribe to MQTT messages using MQTT Publish and MQTT Subscribe blocks. These blocks support MQTT only over TCP/IP sockets.

How to create an API using Python?

- There are different ways to create an API in Python the most used being FastAPI and Flask.

How to create an API in Python with Flask:

- First of all, create an API in Python using Flask we must install the flask and flask-restful packages.
- Once we have the libraries installed, we have to to create our server, as we did with FastAPI.
- We can do this with the following command:

```
from flask import Flask
app = Flask()
```

- In addition, we will have to indicate that the server to launch together with the port where it should be launched. To do this, at the end of our app we must include the following code:

```
if __name__ == '__main__':
    app.run(debug=True, port=8000)
```

- Once we have our server created and we have indicated on which port it should run, we can start creating our APIs.
- To create an API in Python with Flask, we have to indicate: the endpoint, the method and the function that should be executed on that endpoint.
- Let's see an example with an API that simply returns the text "Hello world!".

```
from flask import Flask, jsonify, request,send_file
app = Flask()
@app.route('/my-first-api', method = ['GET'])
def hello():
    return "Hello world!"
```

Note:

- Flask is a framework that allows you to create entire web applications.
- FastAPI performs the validation of the data types that we perform, as well as the entire documentation process, saving us a lot of time compared to whether We do it in Flask.

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Unit – 05: IoT Applications

- ➢ Industrial IoT and Internet of everything
- ➢ IoT for consumer electronics products
- ➢ IoT for Medical applications
- ➢ IoT for Agriculture
- ➢ IoT for security and Law enforcement

Questions to be discussed:

1. What do you mean by IIoT? What are the application of IIoT?
2. What are the application of IoT in Healthcare?
3. Explain the uses of IoT in agriculture.
4. Discuss in brief IoT application in security and law enforcement.

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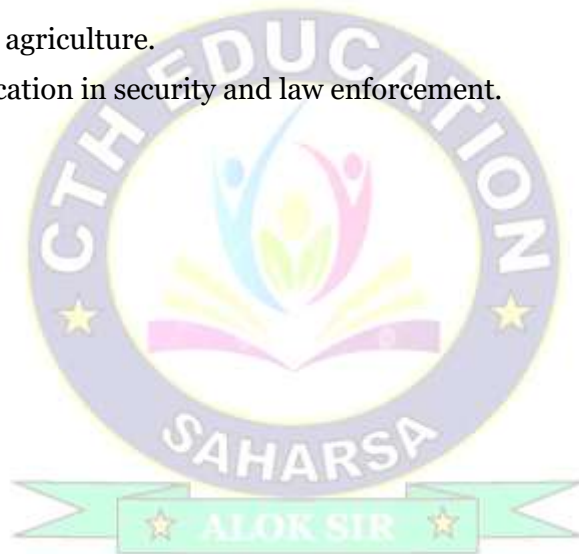
What is IIoT?

- IIoT stands for Industrial Internet of Things.
- It is the use of smart sensors and actuators to enhance manufacturing and industrial processes.
- It is also known as the industrial internet or Industry 4.0.
- The IIoT refers to the extension and use of the IoT in industrial sectors and applications.
- With a strong focus on M2M communication, big data analysis, and machine learning.
- The IIoT enables industries and enterprises to have better efficiency and reliability in their operations.

What are IIoT application:

- Industrial
- Manufacturing
- Robotics
- Smart car
- Smart city
- Smart communication
- Smart power utilities etc.
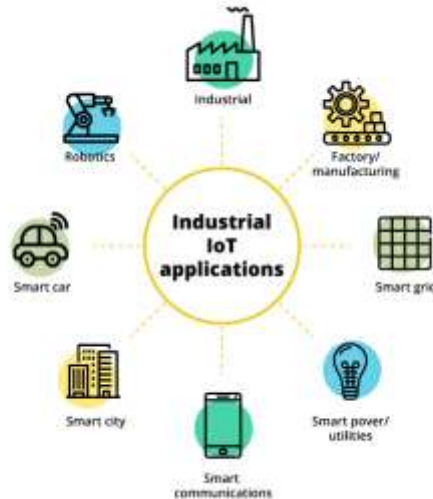
Many industry uses IoT some of them are given below:

Automotive industry:

- The automotive industry uses IIoT devices in the manufacturing process.
- It uses industrial robots, and IIoT can help proactively maintain these systems and spot potential problems before they can disrupt production.

Agriculture industry:

- The agriculture industry makes extensive use of IIoT devices, too.
- Industrial sensors collect data about soil nutrients, moisture and more, enabling farmers to produce an optimal crop.

Oil and gas industry:

- Some oil companies maintain a fleet of autonomous aircraft that can use visual and thermal imaging to detect potential problems in pipelines.
- This information is combined with data from other types of sensors to ensure safe operations.

What is CIoT?

- CIoT stands for Consumer Internet of Things.
- It is an interconnected system of physical and digital objects, personally used by a consumer.
- Consumer IoT covers all the user's network around their personal and home devices.
- In IoT, the devices are integrated with multiple wireless technologies and microcontrollers.
- That makes it easier to share consumer data and information without any individual's direct interaction with each other or the computer.
- CIoT devices divided into two types:
  1. Personal IoT
  2. Smart Home IoT
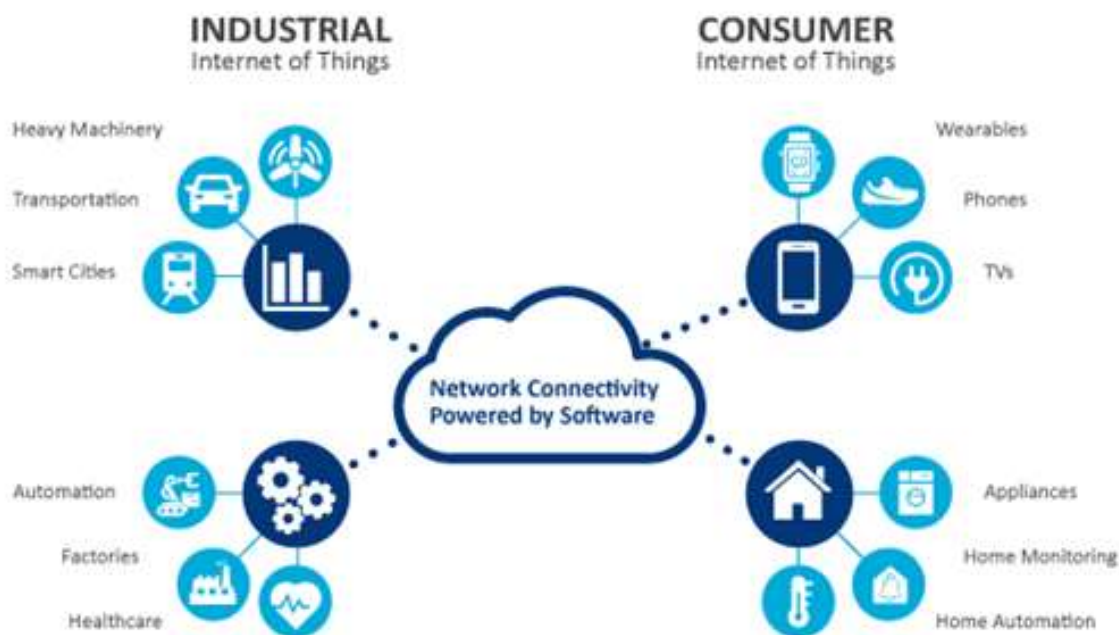
Personal IoT:

- Personal IoT devices and applications include wearable, hearable, smartphones and personal laptop gadgets such as-

Smart Home IoT:

- Smart Home IoT devices and applications include home automation products like smart kitchen gadgets and security systems with face recognition and voice control.

IoT for Medical application:

- The application of IoT in medical transforms it into more smart, fast and more accurate.
- It keeps the patients safe and healthy as well as improves the physician delivers care towards the patients.
- Healthcare devices collect diverse data from a large set of real-world cases that increases the accuracy and the size of medical data.
- There are various IoT Applications in medical:
  - Implantable Glucose Monitoring Systems
  - Activity Trackers During Cancer Treatment
  - Heart Monitors with Reporting
  - Medical Alert Systems
  - Wireless Sensors
  - Trackable Inhalers
  - Wearables to Fight Depression
  - Connected Contact Lenses
  - Location Services
  - Remote Monitoring

IOT in Agriculture:

- IOT accessing and controlling daily usable devices and equipment using the Internet.
- The term "Things" in the IoT refers to anything and everything in day-to-day life which is accessed or connected through the internet.
- Agriculture is another important domain for IOT.
- IOT systems play an important role for crop and soil monitoring and give a proper solution accordingly.
- IOT leads to smart farming.
- Using IOT, farmers can minimize waste and increase productivity.
- The system allows the monitoring of fields with the help of sensors.
- Farmers can monitor the status of the area.

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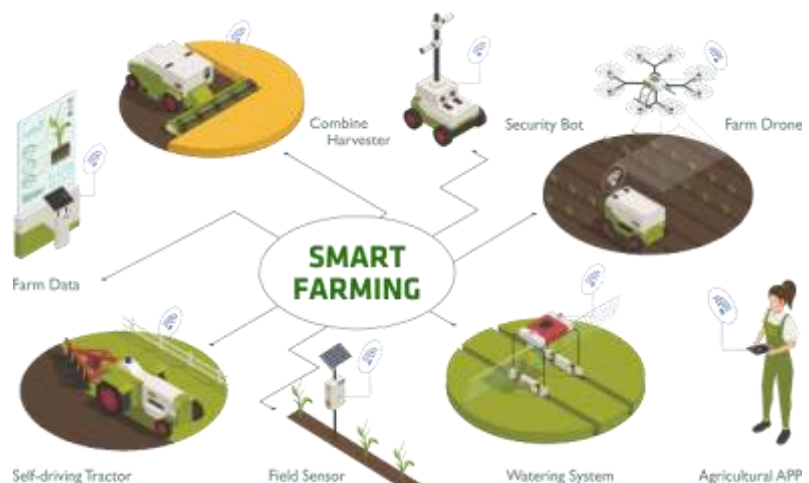
What is IoT security?

- IoT devices are computerized Internet-connected objects, such as networked security cameras, smart refrigerators, WiFi-capable automobiles etc.
- IoT security is the process of securing IoT devices & ensuring they do not introduce threats into a network.
- IoT security refers to the methods of protection used to secure internet-connected devices.
- Anything connected to the Internet is likely to face attack at some point.
- Attackers can try to remotely compromise IoT devices using a variety of methods, from credential theft to vulnerability exploits.

Law Enforcement Applications of IoT:

- IoT enhances law enforcement organizations and improves the justice system.
- The technology boosts transparency, distributes critical data, and removes human intervention where it proves unnecessary.
- This ensures strict adherence to the rules and guidelines by the government.
- The following are a few of the IoT applications in law enforcement among citizens of any country or state:
  - Traffic signals sensors to avoid road accidents
  - Wearables for officers and government officials
  - Drones for border patrol
  - IoT in courts
  - Policing
  - Maintaining Law and order with IoT
  - Detection of crime
  - Gathering of evidence
  - IoT firearms
  - Smart Vehicles etc.