

- Q- / iot & M2M M2M (machine to machine)
- Beam Search,
- Overview and Historical Perspective --with diagram
- AI, Agent - all figure denoted with graph chart
- Use pencil

Definition and Characteristics of IoT

Internet of Things (IoT) ek aisi technology hai jisme different devices jaise mobile, fridge, cars, smartwatches, lights, etc. internet ke through ek dusre se connected hote hain. Ye devices ek dusre se baat kar sakte hain aur data share karte hain bina human ko manually control kiye.

Characteristics of IoT:

1. ****Connectivity****: Devices ko internet ke through connect kiya jata hai, jisse wo data exchange karte hain.
2. ****Automation****: IoT devices khud se kaam karte hain bina kisi human interference ke. Jaise smart light apne aap off/on ho jati hai.
3. ****Real-time data****: IoT devices real-time data collect aur process karte hain, jaise fitness band jo heart rate real-time track karta hai.
4. ****Remote Access****: Aap IoT devices ko dur se control kar sakte ho, jaise apne phone se ghar ki lights ya AC on karna.
5. ****Data Sharing****: Sabhi IoT devices aapas me continuously data share karte hain, jo ki unke decisions aur functioning ko smart banata hai.

Example:

Smart Home: Ghar ki lights, AC, fridge, sab IoT se connected hain. Aap phone se ghar se door hote hue bhi lights on/off kar sakte ho, temperature set kar sakte ho, aur fridge ka status check kar sakte ho.

Sensors, Actuators,

Sensors:

Sensors wo devices hote hain jo environment se data collect karte hain. Ye physical changes ko detect karte hain, jaise temperature, light, motion, humidity, etc., aur unhe digital signals me convert karte hain taaki IoT system ko samajh aaye.

•Example:

- **Temperature sensor:** Ghar ka thermostat jo room ka temperature detect karta hai aur heating ya cooling system ko adjust karta hai.
- **Motion sensor:** Jo aapke ghar ke lights ko on/off karta hai jab wo movement detect karta hai.



Actuators:

Actuators wo devices hote hain jo sensors ke data ke response me action perform karte hain. Ye physical actions ko control karte hain, jaise switch on karna, move karna, ya adjust karna.

•Example:

- **Smart Light:** Jab motion sensor detect kare ki koi room me aaya hai, toh actuator light ko on kar dega.
 - **Smart Door Lock:** Aapke phone se signal milne par door lock ko open ya close karta hai.

How Sensors and Actuators Work Together?

•Example of a Smart Thermostat:

- **Sensor:** Temperature sensor detect karta hai ki room thanda hai (let's say below 20°C).
- **Actuator:** Actuator heating system ko on kar deta hai taaki room ka temperature increase ho jaye.

Is tarah se **Sensors** environment se data detect karte hain aur **Actuators** us data ke hisaab se action lete hain.

Physical Design of IoT

Physical design of IoT ka matlab hai ki IoT system me jo real, physical devices involved hote hain, unka structure aur components kya hote hain. Isme primarily do main components hote hain: **"Things"** (Devices) aur **Communication**.

1. "Things" (IoT Devices):

Ye wo physical objects ya devices hote hain jo sensors aur actuators ko use karke data collect ya actions perform karte hain. In devices ko hum "smart devices" bhi bolte hain.

Things (IoT Devices):

- **Sensors:** Environment se data collect karte hain.
 - Example: Temperature sensor.
- **Actuators:** Collected data pe action perform karte hain.
 - Example: AC on/off karna.
- **Embedded Systems:** Sensors aur actuators ko control karne wale chhote processors.
 - Example: Raspberry Pi, Arduino.

Physical Design of IoT

2. Communication:

IoT devices ko kaam karne ke liye apas me aur centralized systems ke sath baat karna hota hai, jo ki **Communication protocols** ke through hota hai. Devices ko internet ya local network ke through connect kiya jata hai, aur ye continuous data transfer aur action commands ko enable karta hai.

1. **Network:** Devices apas me Wi-Fi, Bluetooth, Zigbee ke through connected hote hain.
2. **Cloud Platform:** Data cloud pe store aur process hota hai (Google Cloud, AWS).

Example: Smart home system jaha sensors detect karte hain aur actuators action lete hain.

IoT Protocols

IoT Protocols

IoT Protocols wo set of rules hote hain jo IoT devices ke beech communication ko define karte hain. Ye protocols ensure karte hain ki IoT devices securely aur efficiently data transfer kar sakein.

1. **Network:** Devices apas me Wi-Fi, Bluetooth, Zigbee ke through connected hote hain.
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Common IoT Protocols

- MQTT**: Lightweight protocol for low-bandwidth environments.
- Use**: Smart homes, healthcare.
- CoAP**: For small, resource-constrained devices.
- Use**: Smart meters, sensors.
- HTTP**: Standard web protocol but heavy for IoT.
- Use**: Web-based IoT apps.
- AMQP**: Secure and reliable messaging.
- Use**: Banking, enterprise IoT.
- Zigbee**: Low-power, short-range communication.
- Use**: Smart lights, home automation.
- Bluetooth**: Short-range wireless communication.
- Use**: Wearables, fitness trackers.

IoT communication models,

- IoT (Internet of Things) communication models define how devices in an IoT ecosystem communicate with each other and the broader network. There are four main types of IoT communication models:
- IoT (Internet of Things) communication models ka matlab hota hai kaise devices ek dusre se ya network ke saath baat karte hain. IoT mein 4 main communication models hote hain:
 - ### 1. **Device-to-Device (D2D) Communication**
 - - **Explanation**: Is model mein devices directly ek dusre se baat karte hain, bina kisi central system (server ya cloud) ke.
 - - **Example**: Bluetooth devices ya Zigbee-based communication, jaise smart home devices (light bulbs, thermostats) ka ek dusre se connection.
 - - **Use Case**: Short-range, low-power communication ke liye best hai, jaise smart home ya wearable devices.

- ### 2. **Device-to-Cloud (D2C) Communication**
 - - **Explanation**: Devices directly cloud platform se baat karte hain data exchange ke liye. Cloud processing, storage, aur control karta hai.
 - - **Example**: Smart thermostat jo temperature data cloud ko bhejta hai for analytics aur smartphone app se control ke liye.
 - - **Use Case**: Jab real-time data processing, storage, aur remote control chahiye, tab useful hai.
- ### 3. **Device-to-Gateway (D2G) Communication**
 - - **Explanation**: Devices ek gateway ke through communicate karte hain (jaise smartphone, router, ya hub), jo data ko cloud ya dusre network tak pahuchata hai.
 - - **Example**: Ghar ke smart devices ek central hub ko data bhejte hain, jo fir cloud tak forward karta hai.
 - - **Use Case**: Ye security badhata hai aur devices ka load kam karta hai, kyunki gateway data ko process aur communicate karta hai.
- ### 4. **Back-End Data-Sharing Model**
 - - **Explanation**: Is model mein devices indirectly baat karte hain, data ek cloud-based ya server system ke through share karte hain. Alag-alag devices ka data ek saath process hota hai aur share hota hai.
 - - **Example**: City ke traffic sensors ka data ek central cloud platform par share hota hai for real-time traffic management.
 - - **Use Case**: Large-scale data integration aur analytics ke liye best hai, jaise smart cities ya industrial IoT.
- Ye communication models different use cases ke liye banaaye gaye hain, aur inka selection network reliability, data complexity aur power consumption par depend karta hai.

IOT ENABLED TECHNOLOGIES – WIRELESS SENSOR NETWORKS, CLOUD COMPUTING, EMBEDDED SYSTEMS, IOT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry. all of these about some define , this is my college syllabus

1. IoT Enabled Technologies:

IoT (Internet of Things) mein kuch important technologies use hoti hain jo devices ko connect karne aur data share karne mein madad karti hain. Let's understand them one by one:

1.1 Wireless Sensor Networks (WSN):

- WSN ek group hota hai sensors ka jo wirelessly connect hote hain aur real-time environment ke data ko collect karte hain.
- Example: Soil moisture sensors jo agriculture mein use hote hain, ek WSN ka part hote hain jo continuously soil ki condition ko monitor karte hain.

1.2 Cloud Computing:

- Cloud computing ka use IoT data ko store aur process karne ke liye hota hai. Devices se jo data collect hota hai, wo cloud mein store hota hai jahan se usko process karke meaningful information banaya ja sakta hai.
- Example: Smartwatches ka data (heart rate, steps) cloud mein save hota hai aur uska analysis hota hai.

1.3 Embedded Systems:

- Embedded systems chhote computers hote hain jo devices ke andar hote hain aur unko specific task complete karne ke liye program kiya jata hai.
- Example: Smart fridge ek embedded system use karta hai taaki temperature control kar sake aur food fresh rahe.

2. IoT Levels and Templates:

- IoT systems different levels mein design hote hain, depending on their complexity. Har level different functionalities aur technologies ko represent karta hai.

2.1 IoT Levels:

- **Level 1:** Single node device, jo local area mein kaam karta hai.
- **Level 2:** Two-node system, jisme data local aur remote location dono mein ja sakta hai.
- **Level 3-5:** Large scale IoT networks, jo complex systems ko connect karte hain jaise ek pura smart city system.

2.2 IoT Templates:

- Templates pre-defined structures ya models hote hain jo different types ke IoT applications banane ke liye help karte hain.
- Example: Agar aap ek smart home IoT system banane ja rahe hain, toh ek template mein sensors, actuators, cloud storage, aur processing ka pre-defined framework hoga.

3. Domain-Specific IoTs:

Different domains mein IoT technologies ka alag tarike se use hota hai. Yaha kuch major domains aur unme IoT ka use:

3.1 Home (Smart Homes):

- IoT ka use smart devices jaise smart lights, thermostats, cameras etc ko control karne ke liye hota hai. Yeh devices wirelessly ek doosre se connect hote hain aur mobile apps ya voice assistants se control kiye ja sakte hain.
- Example: Amazon Alexa, Google Home.

3.2 City (Smart Cities):

- Smart cities mein IoT ka use infrastructure, traffic, safety, aur public services ko improve karne ke liye hota hai.
- Example: Smart traffic lights jo traffic flow ke hisaab se adjust ho jati hain.

3.3 Environment:

- IoT devices environmental conditions jaise pollution, temperature, humidity, etc ko monitor karte hain.
- Example: Air quality monitoring systems jo pollution ko track karte hain aur alerts bhejte hain.

3.4 Energy (Smart Grid):

- Energy management ke liye IoT ka use smart meters aur energy-efficient devices ke through hota hai. Smart grids real-time data ko analyze karke energy usage ko optimize karte hain.
- Example: Smart meters jo electricity consumption ko track karte hain.

3.5 Agriculture (Smart Farming):

- Agriculture mein IoT sensors aur automation ka use karke farming activities ko optimize karne mein madad hoti hai.
- Example: Soil sensors jo moisture level ko check karte hain aur irrigation systems ko automatic control karte hain.

3.6 Industry (Industrial IoT):

- Industry 4.0 mein IoT ka major role hai. Machines aur production lines ko smart banaya ja raha hai taki unhe remotely monitor aur control kiya ja sake.
- Example: Smart factories jahan machinery ko ek central system ke through control kiya jata hai.

Conclusion:

Yeh topics IoT technologies ka different aspects cover karte hain, jaise wireless networks, cloud computing, aur unka specific domains mein use. IoT ka main goal yeh hai ki real-time data collect kiya jaye, analyze kiya jaye, aur smart decisions liye jaaye.