# Introduction to IOT
# Unit-1 (AIDS-309)

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# AGENDA

# Introduction to IOT

# Agenda

- **Introduction to IOT**
- **Why IOT?**
- **Advantages of IOT**
- **Disadvantages of IOT**
- **Characteristics of IOT**
- **IOT of Use Cases**
- **Explain the definition and usage of IOT in different context**
- **Design principles for connected devices.**

# What is a IOT?

- IOT which is also known as internet of things refers to the network of physical objects or "things" that are embedded with sensors, software, and connectivity capabilities, allowing them to collect and exchange data over the internet.
- These objects can be everyday items such as appliances, vehicles, wearable devices, industrial machinery, or even buildings.
- The concept behind IoT is to enable these objects to communicate with each other, as well as with humans, creating a connected ecosystem where data can be collected, analyzed, and utilized to drive various applications and services.

# IOT in laymen terms?

- Think of your cellphone before it was a smartphone. You could call and you could text sure, but now you can read any book, watch any movie, or listen to any song all in the palm of your hand. And that's just to name a few of the incredible things your smartphone can do.
- The point is that connecting things to the internet yields many amazing benefits. We've all seen these benefits with our smartphones, laptops, and tablets, but this is true for everything else too.
- ***The Internet of Things is actually a pretty simple concept, it means taking all the things in the world and connecting them to the internet.***

# Why IOT matters?

- When something is connected to the internet, that means that it can send information or receive information, or both.
- This ability to send and/or receive information makes things smart, and smart is good.
- Let’s use smartphones (smartphones) again as an example. Right now you can listen to just about any song in the world, but it’s not because your phone actually has every song in the world stored on it.
- It’s because every song in the world is stored somewhere else, but your phone can send information (asking for that song) and then receive information (streaming that song on your phone).

# Why IOT matters?

- ***To be smart, a thing doesn't need to have super storage or a super computer inside of it. All a thing has to do is connect to super storage or to a super computer. Being connected is awesome.***
- In the Internet of Things, all the things that are being connected to the internet can be put into three categories:

1. Things that collect information and then send it.
2. Things that receive information and then act on it.
3. Things that do both.

# Collecting and Sending Information

- This means sensors. Sensors could be temperature sensors, motion sensors, moisture sensors, air quality sensors, light sensors, you name it.
- These sensors, along with a connection, allow us to automatically collect information from the environment which, in turn, allows us to make more intelligent decisions.
- Just as our sight, hearing, smell, touch, and taste allow us, humans, to make sense of the world, sensors allow machines to make sense of the world.

# Collecting and Sending Information

- **Soil moisture sensor**

On the farm, automatically getting information about the soil moisture can tell farmers exactly when their crops need to be watered. Instead of watering too much (which can be an expensive over-use of irrigation systems) or watering too little (which can be an expensive loss of crops), the farmer can ensure that crops get exactly the right amount of water. More money for farmers and more food for the world!

# Receiving and Acting on Information

- We’re all very familiar with machines getting information and then acting. Our printer receives a document and it prints it. Our car receives a signal from your car keys and the doors open. The examples are endless.
- Whether it’s a simple as sending the command “turn on” or as complex as sending a 3D model to a 3D printer, we know that we can tell machines what to do from far away. So what?
- The real power of the Internet of Things arises when things can do both of the above. Things that collect information and send it, but also receive information and act on it.

# Doing Both

- Let’s quickly go back to the farming example. The sensors can collect information about the soil moisture to tell the farmer how much to water the crops, but you don’t actually need the farmer.
- Instead, the irrigation system can automatically turn on as needed, based on how much moisture is in the soil.
- You can take it a step further too. If the irrigation system receives information about the weather from its internet connection, it can also know when it’s going to rain and decide not to water the crops today because they’ll be watered by the rain anyways.

# Doing Both

- And it doesn’t stop there! All this information about the soil moisture, how much the irrigation system is watering the crops, and how well the crops actually grow can be collected and sent to supercomputers that run amazing algorithms that can make sense of all this information.
- And that’s just one kind of sensor. Add in other sensors like light, air quality, and temperature, and these algorithms can learn much more.
- With dozens, hundreds, thousands of farms all collecting this information, these algorithms can create incredible insights into how to make crops grow the best, helping to feed the world.

# Advantages of IOT

1. Minimizes the human work and effort.
2. Saves time and effort.
3. Good for personal safety and security.
4. Useful in traffic and other tracking or monitoring systems.
5. Beneficial for the healthcare industry.
6. Improved security in homes and offices.
7. Reduced use of many electronic devices as one device does the job of a lot of other devices.

# Disadvantages of IOT

1. Increased privacy concerns.
2. Increased unemployment rates.
3. Highly dependent on the internet.
4. Lack of mental and physical activity by humans leading to health issues.
5. Complex system for maintenance.
6. Lack of security.
7. Absence of international standards for better communication.

# Characteristics of the Internet of Things:

1. **Connectivity —** Connectivity is an important requirement of the IoT infrastructure. Things of IoT should be connected to the IoT infrastructure. Anyone, anywhere, anytime can connect, this should be guaranteed at all times. For example, the connection between people through internet devices like mobile phones, and other gadgets, also a connection between Internet devices such as routers, gateways, sensors, etc.
2. **Intelligence and Identity —** The extraction of knowledge from the generated data is very important. For example, a sensor generates data, but that data will only be useful if it is interpreted properly. Each IoT device has a unique identity. This identification is helpful in tracking the equipment and at times for querying its status.

# Characteristics of the Internet of Things:

3. **Scalability —** The number of elements connected to the IoT zone is increasing day by day. Hence, an IoT setup should be capable of handling the massive expansion. The data generated as an outcome is enormous, and it should be handled appropriately.
4. **Dynamic and Self-Adapting (Complexity)** –IoT devices should dynamically adapt themselves to changing contexts and scenarios. Assume a camera meant for surveillance. It should be adaptable to work in different conditions and different light situations (morning, afternoon, and night).

# Characteristics of the Internet of Things:

5. **Architecture —** IoT architecture cannot be homogeneous in nature. It should be hybrid, supporting different manufacturers ‘ products to function in the IoT network. IoT is not owned by anyone engineering branch. IoT is a reality when multiple domains come together.
6. **Safety —** There is a danger of the sensitive personal details of the users getting compromised when all his/her devices are connected to the internet. This can cause a loss to the user. Hence, data security is the major challenge. Besides, the equipment involved is huge. IoT networks may also be at the risk. Therefore, equipment safety is also critical.

# IoT notable Use Cases

## 1. Smart Homes

- **Home Automation:** Devices like smart thermostats (e.g., Nest), smart lights (e.g., Philips Hue), and smart locks (e.g., August Smart Lock) allow users to control home environments remotely.
- **Security Systems:** Connected cameras and sensors (e.g., Ring, Arlo) enable real-time surveillance and alerts, enhancing home security.

## 2. Healthcare

- **Remote Patient Monitoring:** Devices like wearables (e.g., Fitbit, Apple Watch) and connected medical devices (e.g., glucose monitors) track vital signs and health metrics, allowing for continuous patient monitoring and timely interventions.
- **Smart Hospitals:** IoT devices manage inventory, track medical equipment, and monitor environmental conditions to ensure optimal patient care.

# IoT notable Use Cases

**3. Industrial IoT (IIoT)**

- **Predictive Maintenance:** Sensors on machinery and equipment collect data to predict failures before they occur, reducing downtime and maintenance costs.
- **Supply Chain Management:** IoT devices track goods throughout the supply chain, providing real-time data on location, temperature, and condition, improving inventory management and reducing losses.

**4. Smart Cities**

- **Traffic Management:** IoT sensors and cameras monitor traffic flow and adjust traffic signals in real-time to reduce congestion.
- **Waste Management:** Smart bins equipped with sensors detect fill levels and optimize waste collection routes, reducing costs and improving efficiency.

# IoT notable Use Cases

## 5. Agriculture

- **Precision Farming:** IoT devices like soil moisture sensors, weather stations, and drone technology help farmers monitor crop health, optimize water usage, and increase yields.
- **Livestock Monitoring:** Connected collars and tags monitor the health and location of livestock, improving animal welfare and farm productivity.

## 6. Retail

- **Inventory Management:** IoT-enabled shelves and RFID tags provide real-time inventory tracking, reducing stockouts and overstock situations.
- **Customer Experience:** Beacon technology and smart displays offer personalized shopping experiences and targeted promotions.

# IoT notable Use Cases

## 7. Energy Management

- **Smart Grids:** IoT devices help in monitoring and managing electricity consumption, enabling more efficient energy distribution and reduced wastage.
- **Smart Meters:** Provide real-time data on energy usage to both consumers and utility providers, promoting energy conservation and cost savings.

## 8. Transportation and Logistics

- **Fleet Management:** IoT solutions monitor vehicle performance, driver behavior, and route efficiency, enhancing logistics operations and reducing operational costs.
- **Connected Vehicles:** IoT technologies in vehicles offer features like predictive maintenance, real-time navigation, and enhanced safety systems.

# Explain the definition and usage of IOT in different context

**Definition:**

- The Internet of Things (IoT) refers to a network of physical objects—devices, vehicles, appliances, and other items embedded with sensors, software, and other technologies—that are connected to the internet and can collect, exchange, and act on data.
- The primary goal of IoT is to create a smarter, more responsive environment through automation and real-time information sharing.

# Usage in Different Contexts:

- **Home Automation:**

***Smart Homes:*** IoT devices like smart thermostats, lighting systems, security cameras, and smart speakers enhance convenience, energy efficiency, and security in homes. These devices can be controlled remotely via smartphones or through voice commands.

***Health Monitoring:*** Wearable IoT devices such as fitness trackers and smartwatches monitor health metrics like heart rate, sleep patterns, and physical activity, providing insights and alerts for better health management.

- **Industry and Manufacturing:**

***Industrial IoT (IIoT):*** In factories, IoT devices are used for predictive maintenance, monitoring equipment health, optimizing production processes, and ensuring safety. Connected sensors can alert managers to potential issues before they lead to equipment failure.

***Supply Chain Management:*** IoT enables real-time tracking of goods in transit, ensuring better inventory management, reducing delays, and enhancing the overall efficiency of the supply chain.

- **Healthcare:**

***Remote Patient Monitoring:*** IoT devices can monitor patients' vital signs in real-time and transmit the data to healthcare providers, enabling timely interventions and reducing hospital readmissions.

***Smart Medical Devices:*** Connected devices like insulin pumps, smart inhalers, and connected imaging systems improve the accuracy and effectiveness of treatments.

- **Transportation:**

***Smart Transportation:*** IoT technology is used in smart traffic management systems to optimize traffic flow, reduce congestion, and improve safety. Connected vehicles can communicate with each other and with traffic infrastructure to enhance driving experience and safety.

***Fleet Management:*** IoT helps in tracking vehicle locations, monitoring driver behavior, and managing maintenance schedules, thereby improving operational efficiency and reducing costs.

- **Agriculture:**

***Precision Agriculture:*** IoT devices such as soil moisture sensors, weather stations, and drones provide farmers with detailed insights into crop health, soil conditions, and weather patterns, enabling more efficient and sustainable farming practices.

***Livestock Monitoring:*** IoT can be used to track the health and location of livestock, ensuring better management of resources and timely intervention in case of health issues.

- **Energy Management:**

***Smart Grids:*** IoT plays a crucial role in the development of smart grids, which use real-time data to balance supply and demand, detect outages, and improve the efficiency of electricity distribution.

***Energy Consumption Monitoring:*** IoT devices can monitor and optimize energy consumption in buildings and homes, reducing costs and environmental impact.

- **Environmental Monitoring:**

***Air and Water Quality Monitoring:*** IoT sensors can track pollution levels in real-time, providing data that helps in regulatory compliance and public health protection.

***Wildlife Monitoring:*** IoT technology helps in tracking the movement and behavior of wildlife, aiding in conservation efforts and ecological research.

# Design Principles for Connected Devices in the IoT

- **Interoperability:**

**Definition:** Devices must be able to communicate and work together, regardless of manufacturer or platform.

**Implementation:** Use standard communication protocols and APIs. Ensure compatibility with other devices and systems.

- **Security:**

**Definition:** Protect data integrity and privacy from unauthorized access or breaches.

**Implementation:** Implement strong encryption, authentication, and regular security updates. Follow best practices in cybersecurity.

- **Scalability:**

**Definition:** Systems should be able to grow and manage increased demand.

**Implementation:** Design with modularity in mind, allowing for easy addition of devices and increased capacity without significant overhauls.

- **Reliability:**

**Definition:** Devices should function consistently and accurately over time.

**Implementation:** Use robust hardware and software testing. Design for redundancy and failover capabilities to minimize downtime.

- **Energy Efficiency:**

**Definition:** Minimize power consumption to extend the battery life of devices.

**Implementation:** Use low-power hardware, optimize software for energy efficiency, and employ energy-saving modes.

- **User-Centric Design:**

**Definition:** Devices should be intuitive and easy to use for the end-user.

**Implementation:** Prioritize user experience (UX) in the design process, provide clear interfaces, and ensure easy installation and maintenance.

- **Maintainability:**

**Definition:** Devices should be easy to maintain, update, and repair.

**Implementation:** Design for modularity, allowing parts to be easily replaced or upgraded. Provide over-the-air (OTA) software updates.

- **Cost-Effectiveness:**

**Definition:** Keep the cost of devices and their operation as low as possible.

**Implementation:** Use affordable components without compromising on quality, optimize production processes, and ensure efficient operation to reduce operational costs.

- **Data Integrity:**

**Definition:** Ensure data collected and transmitted is accurate and reliable.

**Implementation:** Implement error-checking algorithms, validate data at multiple points, and use secure communication channels.

- **Latency:**

**Definition:** Minimize delay in data transmission and device response time.

**Implementation:** Optimize network architecture, use high-speed communication protocols, and minimize processing time within devices.

- **Compliance:**

**Definition:** Adhere to relevant regulations and standards for IoT devices.

**Implementation:** Stay informed about industry standards and regulations. Ensure your devices meet necessary certifications and compliance requirements.

# THANK YOU