

IOT Introduction

IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.

As we have a platform such as a cloud that contains all the data through which we connect all the things around us. For example, a house, where we can connect our home appliances such as air conditioner, light, etc. through each other and all these things are managed at the same platform. Since we have a platform, we can connect our car, track its fuel meter, speed level, and also track the location of the car.

Advancements in medicine, power, gene therapies, agriculture, smart cities, and smart homes are just a very few of the categorical examples where IoT is strongly established.

Over 9 billion 'Things' (physical objects) are currently connected to the Internet, as of now. In the near future, this number is expected to rise to a whopping 20 billion.

There are four main components used in IoT:

1.Low-power embedded systems –

Less battery consumption, high performance are the inverse factors play a significant role during the design of electronic systems.

2.Cloud computing –

Data collected through IoT devices is massive and this data has to be stored on a reliable storage server. This is where cloud computing comes into play. The data is processed and learned, giving more room for us to discover where things like electrical faults/errors are within the system.

3.Availability of big data –

We know that IoT relies heavily on sensors, especially real-time. As these electronic devices spread throughout every field, their usage is going to trigger a massive flux of big data.

4.Networking connection –

In order to communicate, internet connectivity is a must where each physical object is represented by an IP address. However, there are only a limited number of addresses available according to the IP naming. Due to the growing number of devices, this naming system will not be feasible anymore. Therefore, researchers are looking for another alternative naming system to represent each physical object.

Characteristics of IoT:

- Massively scalable and efficient
- IP-based addressing will no longer be suitable in the upcoming future.
- An abundance of physical objects is present that does not use IP, so IoT is made possible.
- Devices typically consume less power. When not in use, they should be automatically programmed to sleep.
- A device that is connected to another device right now may not be connected in another instant of time.

- Intermittent connectivity – IoT devices aren't always connected. In order to save bandwidth and battery consumption, devices will be powered off periodically when not in use. Otherwise, connections might turn unreliable and thus prove to be inefficient.

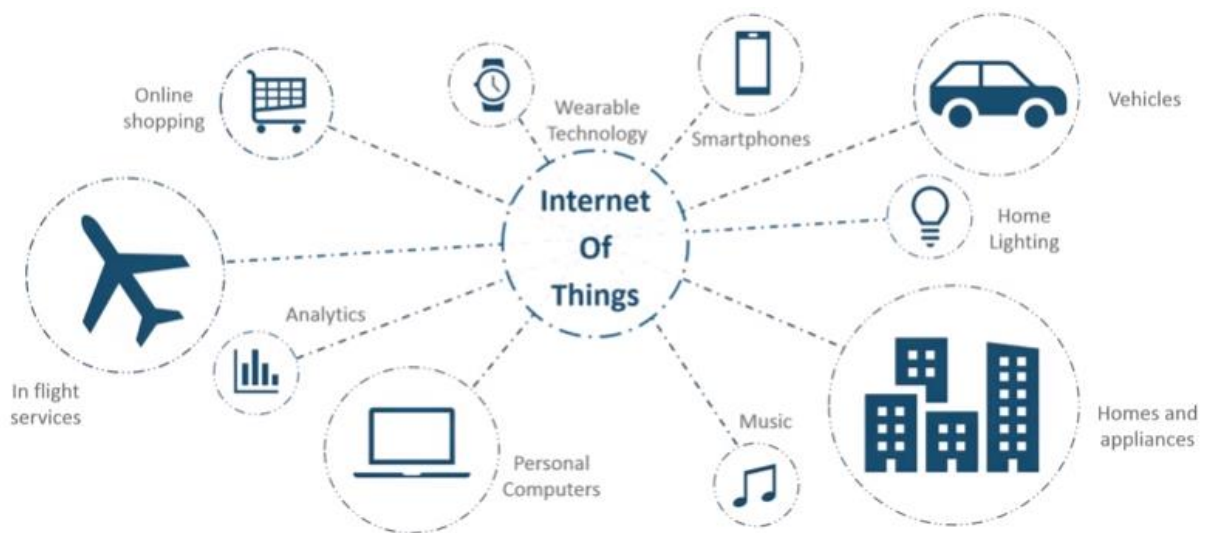
Application Domains:

IoT is currently found in four different popular domains:

- 1) Manufacturing/Industrial business - 40.2%
- 2) Healthcare - 30.3%
- 3) Security - 7.7%
- 4) Retail - 8.3%

Modern Applications:

1. Smart Grids
2. Smart cities
3. Smart homes
4. Healthcare
5. Earthquake detection
6. Radiation detection/hazardous gas detection
7. Smartphone detection
8. Water flow monitoring



Features of IOT

The most important features of IoT on which it works are connectivity, analyzing, integrating, active engagement, and many more. Some of them are listed below:

Connectivity: Connectivity refers to establish a proper connection between all the things of IoT to IoT platform it may be server or cloud. After connecting the IoT devices, it needs a high speed messaging between the devices and cloud to enable reliable, secure and bi-directional communication.

Analyzing: After connecting all the relevant things, it comes to real-time analyzing the data collected and use them to build effective business intelligence. If we have a good insight into data gathered from all these things, then we call our system has a smart system.

Integrating: IoT integrating the various models to improve the user experience as well.

Artificial Intelligence: IoT makes things smart and enhances life through the use of data. For example, if we have a coffee machine whose beans have going to end, then the coffee machine itself order the coffee beans of your choice from the retailer.

Sensing: The sensor devices used in IoT technologies detect and measure any change in the environment and report on their status. IoT technology brings passive networks to active networks. Without sensors, there could not hold an effective or true IoT environment.

Active Engagement: IoT makes the connected technology, product, or services to active engagement between each other.

Endpoint Management: It is important to be the endpoint management of all the IoT system otherwise, it makes the complete failure of the system. For example, if a coffee machine itself order the coffee beans when it goes to end but what happens when it orders the beans from a retailer and we are not present at home for a few days, it leads to the failure of the IoT system. So, there must be a need for endpoint management.

Advantages and Disadvantages of (IoT)

Advantages of IoT

Internet of things facilitates the several advantages in day-to-day life in the business sector. Some of its benefits are given below:

Efficient resource utilization: If we know the functionality and the way that how each device work we definitely increase the efficient resource utilization as well as monitor natural resources.

Minimize human effort: As the devices of IoT interact and communicate with each other and do lot of task for us, then they minimize the human effort.

Save time: As it reduces the human effort then it definitely saves out time. Time is the primary factor which can save through IoT platform.

Enhance Data Collection:

Improve security: Now, if we have a system that all these things are interconnected then we can make the system more secure and efficient.

Disadvantages of IoT

As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below:

Security: As the IoT systems are interconnected and communicate over networks. The system offers little control despite any security measures, and it can lead to various kinds of network attacks.

Privacy: Even without the active participation of the user, the IoT system provides substantial personal data in maximum detail.

Complexity: The designing, developing, and maintaining and enabling the large technology to IoT system is quite complicated.

The 4 Levels of IoT Implementation

The Internet of Things (IoT) gives companies more reach and features to build advanced products. For instance, a toothbrush maker is no longer just concerned with making plastic toothbrush handles anymore. With IoT, they may now come up with electronic devices that would give their ordinary toothbrushes the ability to track the way a user brushes their teeth and to advise them on dental hygiene. And this trend goes beyond IT and manufacturing companies. There are many ways that enterprises can leverage IoT technologies. IoT forms the basis for smart cities that are being planned across the world.

There are four levels of IoT implementation happening today.

Level 1: Measurement

This is when you use IoT to simply record data and do nothing more than that. It does not activate or trigger any succeeding action. Using IoT in this manner is the most basic level of implementation and a very good analogy is the electricity meter that power companies use. It exists to take note of how much electricity you are consuming, but it does not alert you when you have used a certain amount of electricity. Such measurement-only IoT devices are increasingly being used by governments to measure and transmit real-time data from streetlights, traffic cameras and other deployments to a central system.

Level 2: Automation

Automation is when you use IoT devices not just to record data but to also execute automated business processes. In this level, businesses must first decide what part of their operation, system or process need the aggregated data and then identify how to process and use this information. For instance, going back to the power meter analogy, an example for IoT with automation would be for the meter to send an automated SMS alert to consumers with details regarding their energy consumption.

Level 3: Innovation

A beautiful thing about IoT is that it lends itself to innovation quite easily. Manufacturers can integrate IoT into their products and can make them more attractive to buyers. The essential thing here is for the business to collaborate with third party hardware and software makers in the IoT deployment process. For instance, in the toothbrush example, the manufacturer would need to collaborate with an electronics provider for the implementation of IoT and with software developers to build apps that can enhance the functionality of these IoT-enabled toothbrushes.

Level 4: IoT All Around, All the Time

This is when you pair IoT with cloud computing. The data you get from IoT and the services you provide using this data lives on the cloud, and users and stakeholders can access this data from anywhere and from any device. A well-executed IoT project uses the internet enabled device to transmit real-time data to a central server, uses algorithms to process this information and then take automated decisions to change the way the end-device works. A number of governments across the world have been planning a future where public utilities may be IoT-enabled in such a way that the resources consumed by them may be optimized in real-time. Imagine a traffic intersection that would change the duration of a signal depending on real-time traffic conditions. The good news is that once you begin your IoT setup, it is quite easy to move up from one level to the next. For instance, once you have all the data to automate your distribution chain, you can use the same IoT

system to deliver more services to your customers – such as real time order fulfillment or order tracking. The end game here is however to identify a true purpose that your IoT-enabled device would serve. Without that, your deployment could end up being a mere gimmick that does not truly solve a problem that your customer faces.

IOT Design Methodology

Designing for the Internet of Things (IoT) is the designing of connected products. IoT systems combine physical and digital components that collect data from physical devices and deliver actionable, operational insights. These components include: physical devices, sensors, data extraction and secured communication, gateways, cloud servers, analytics, and dashboards.

Not only should all these components need to be designed, but their interdependencies must also be fully accounted for.

For product and engineering teams designing IoT systems, the core challenge lies in taking IoT use cases and turning them into a connected system – with full integration, the right IoT communication protocols, security, and a user-friendly look and feel. For industrial manufacturing, IoT product design is also known as Industry 4.0 design.

1.Interoperability

At the most fundamental level, a connected system requires sensors, machines, equipment, and sites, to communicate and exchange data. Interoperability is the underlying principle throughout all Industry 4.0 design processes.

2.Information transparency

The rapid growth of connected devices means continuous bridging between the physical and digital worlds. In this context, information transparency means that physical processes should be recorded and stored virtually, creating a Digital Twin.

3.Technical assistance

A driving benefit of IoT, technical assistance refers to the ability of connected systems to provide and display data that helps people to make better operational decisions and solve issues faster. In addition, IoT-enabled things should assist people in laborious tasks to improve productivity and safety.

4.Decentralized decisions

The final principle of Industry 4.0 design is for the connected system to go beyond assisting and exchanging data, to be able to make decisions and execute requirements according to its defined logic.

Logical Design of IoT

In this article we discuss Logical design of Internet of things. Logical design of IoT system refers to an abstract representation of the entities & processes without going into the low-level specifics of the implementation. For understanding Logical Design of IoT, we describes given below terms.

1. IoT Functional Blocks

An IoT system comprises of a number of functional blocks that provide the system the capabilities for identification, sensing, actuation, communication and management.

functional blocks are:

Device: An IoT system comprises of devices that provide sensing, actuation, monitoring and control functions.

Communication: Handles the communication for the IoT system.

Services: services for device monitoring, device control service, data publishing services and services for device discovery.

Management: This blocks provides various functions to govern the IoT system.

Security: this block secures the IoT system and by providing functions such as authentication, authorization, message and content integrity, and data security.

Application: This is an interface that the users can use to control and monitor various aspects of the IoT system. Application also allow users to view the system status and view or analyze the processed data.

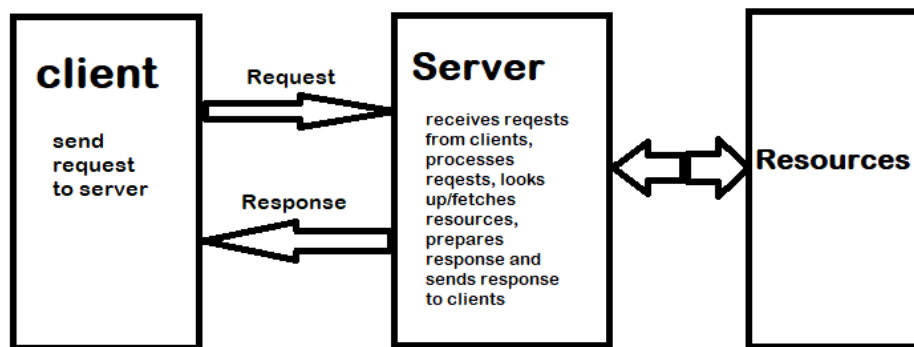
2. IoT Communication Models

Request-Response Model

Request-response model is communication model in which the client sends requests to the server and the server responds to the requests. When the server receives a request, it decides how to respond, fetches the data, retrieves resource representation, prepares the response, and then sends the response to the client. Request-response is a stateless communication model and each request-response pair is independent of others.

HTTP works as a request-response protocol between a client and server. A web browser may be the client, and an application on a computer that hosts a web site may be the server.

Example: A client (browser) submits an HTTP request to the server; then the server returns a



Request-Response Communication Model

response to the client. The response contains status information about the request and may also contain the requested content.

3. IoT Communication APIs

Generally we used Two APIs For IoT Communication. These IoT Communication APIs are:

- a.REST-based Communication APIs
- b.WebSocket-based Communication APIs

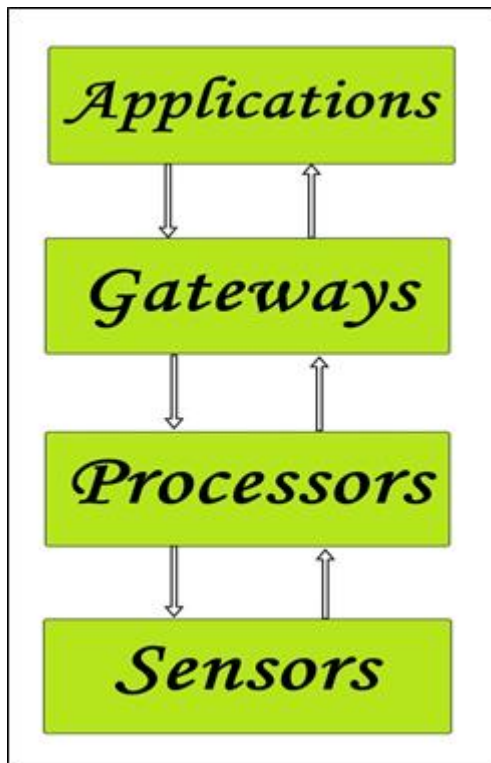
REST-based Communication APIs

Representational state transfer (REST) is a set of architectural principles by which you can design Web services the Web APIs that focus on systems's resources and how resource states are addressed and transferred. REST APIs that follow the request response communication model, the rest architectural constraint apply to the components, connector and data elements, within a distributed hypermedia system. The rest architectural constraint are as follows:

Client-server – The principle behind the client-server constraint is the separation of concerns. for example clients should not be concerned with the storage of data which is concern of the serve. Similarly the server should not be concerned about the user interface, which is concern of the clien. Separation allows client and server to be independently developed and updated.

Building block of IOT model

Four things form basic building blocks of IoT system –sensors, processors, gateways, applications. Each of these nodes has to have their own characteristics in order to form an useful IoT system.



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 surrounding (sensors) or give out data to its surrounding (actuators).

These have to be uniquely identifiable devices with a unique IP address so that they can be easily identifiable over a large network.

These have to be active in nature which means that they should be able to collect real time data. These can either work on their own (autonomous in nature) or can be made to work by the user depending on their needs (user controlled).

Examples of sensors are: gas sensor, water quality sensor, moisture sensor etc.

Processors:

Processors are the brain of the IoT system. Their main function is to process the data captured by the sensors and process them so as to extract the valuable data from the enormous amount of raw data collected. In a word, we can say that it gives intelligence to the data.

Processors mostly work on real-time basis and can be easily controlled by applications. These are also responsible for securing the data – that is performing encryption and decryption of data.

Embedded hardware devices, microcontroller etc are the ones that process the data because they have processors attached to it.

Gateways:

Gateways are responsible for routing the processed data and send it to proper locations for its (data) proper utilization.

In other words, we can say that gateway helps in to and fro communication of the data. 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:

Applications form another end of an IoT system. Applications are essential for proper utilization of all the data collected.

These cloud based applications which are responsible for rendering effective meaning to the data collected. Applications are controlled by users and are delivery point of particular services.

Various technologies making up IOT ecosystems

IoT Ecosystem Components: The Complete Connectivity Layer

The systems are becoming smarter day by day and it is claimed that with time we will be able to see a lot of variations in technology specifically, Internet of Things (IoT). IoT is a network of smart devices, sensors, and actuators that can interconnect with each other.

What are the Key Components?

IoT is not just transforming connectivity among devices and objects but it is also allowing the people to get remote access easily. With so many advantages of IoT, it is interesting to see the main ecosystem components that IoT works on. Here are the main components on which IoT works on.

1. Gateway

Gateway enables easy management of data traffic flowing between protocols and networks. On the other hand, it also translates the network protocols and makes sure that the devices and sensors are connected properly.

It can also work to preprocess the data from sensors and send them off to next level if it is configured accordingly. It is essential to configure it as the presence of TCP/IP protocol allows easy flow.

Not only this, it gives proper encryption with the network flow and data transmission. The data flowed through it is in the higher order that is protected by using latest encryption techniques. You can assume it like an extra layer between the cloud and devices that filter away the attack and illegal network access.

2. Analytics

The analog data of devices and sensors are converted into a format that is easy to read and analyze. This is all possible due to the IoT ecosystem that manages and helps in improving the system. The main factor that is influenced is security.

The most important function of IoT technology is that it supports real-time analysis that easily observes the irregularities and prevents any loss or scam. Preventing the malicious things to attack the smart devices will not only give you a sense of security but also it will save all your private data from being used for illegal purposes.

The big companies collect the data in bulk and analyze it to see the future opportunity so that they can easily develop more business advancement and gain something out of it. This analysis easily helps in setting future trends that have a capability to rule the market. From this analysis, they can be one step ahead of the time and easily achieve success. Data may be a small word but it holds the power to make or break the business if used correctly.

3. Connectivity Of Devices

The main components that complete connectivity layer are sensors and devices. Sensors collect the information and send it off to the next layer where it is being processed. With the advancement of technology, semiconductor technology is used that allows the production of micro smart sensors that can be used for several applications.

The main components are:

Proximity detection,

Humidity or Moisture Level,

Temperature sensors and thermostats,

Pressure sensors,

RFID tags.

The modern smart sensors and devices use various ways to be connected. The wireless networks like LORAWAN, Wi-Fi, and Bluetooth makes it easy for them to stay connected. They have their own advantages and drawbacks that are classified in various forms like efficiency rate, data transfer, and power.

4. Cloud

With the help of internet of things ecosystem, companies are able to collect bulk data from the devices and applications. There are various tools that are used for the purpose of data collection that can collect, process, handle and store the data efficiently in real time. It is also responsible for

making a tough decision that can easily break the deal. This all is done by one system that is IoT Cloud.

It is an intimidating high-performance network that connects servers together to optimize the performance of data process that is being processed by many devices at once. It also helps in controlling traffic and delivering accurate data analytics results.

One of the most important components of IoT cloud is database management that is distributed in nature. The cloud basically combines many devices, gateways, protocols, devices and a data store that can be analyzed efficiently. These systems are used by many companies in order to have improved and efficient data analysis that can help in the development of the services and products. In addition to this, it also helps in forming an accurate strategy that can help in building an ideal business model.

5. User Interface

This is another factor on which IoT ecosystem depends immensely. It provides a visible and physical part that can be easily accessed by the user. It is important for the developer to create a user-friendly interface that could be accessed without putting any extra efforts in it and that can help in easy interaction.

With the help of advancement, there are various interactive designs that could be used easily and that can easily solve any complex query. For examples, at home people have started to use the colorful touch panels instead of the hard controls that were used earlier. It is increasing day by day as now the touchpads are also launched that can switch on the air conditioners from a distance.

This has set out a trend for the digital generations and have managed to hype up today's competitive market. The user interface is the first thing that user pay attention to before buying a device. Even customers are oriented to buy the devices that are user-friendly and less complex that could be used with wireless connectivity.

6. Standards And Protocols

The webpages are now using the HTML format with the cascading style sheet. This has made the internet more stable and reliable service to use. They are the most used standard protocols making it no just friendly but easily acceptable. However, IoT doesn't have that standard.

It is important to choose a platform the IoT that can help in determining the way your platform will interact with the system. Thus, you will be able to have an interaction with devices and networks with the same standard as yours. It is important for having the same protocol to have a successful interaction.

7.Database

Internet of things are increasing dynamically and is all dependent on data that are used immensely in the data centers. It is essential to have a proper database system that can store and manage the data that is being gathered from various device and end-users. There are also various management

tools that offer many automated features that help in easy accumulation of data stored and managed in bulk at the same place.

8. Automation

As mentioned above, the database system is using the automotive features that help in managing data and accumulating it. However, the data management is the only limited thing that is used by the internet of things. It is now used for a much more advanced version that allows the automatic adjustment of the wireless things. For example, you can easily control light with a click of the remote. The air conditioner is now connected to your smartphone and you can switch them on and off whenever you want. Even it is possible to play with the temperature.

9. Development

Internet of things is the latest advancement in technology. The need for the development is growing and increasing with time. Each and every one is not depending on the launch of various automotive devices and smart sensors. There are various prototypes that are in the market that are being deployed and are running in the testing phase. Also, IoT is not working with only one device. Hence, it is important that the devices are completed tested according to the compatibility of the device and checked thoroughly that whether the devices can connect wirelessly or not.

The journey of the internet of things is growing for years. We have managed to experience many things and advancement in most of the technology. IoT ecosystem is used to make the protocols easily accessible, reasonably priced, efficient and secure. It will be excited to see the new demands and development in the several sectors that will be brought by the internet of things.

Especially the way it connects different companies and vendors together. The main is that we need to lookout the way everyone can incorporate this IoT ecosystem to increase their production.