Introduction to Internet of Things (IoT) and Evolution of IoT

It refers to the interconnectedness of physical devices, such as appliances and vehicles, that are embedded with software, sensors, and connectivity which enables these objects to connect and exchange data. This technology allows for the collection and sharing of data from a vast network of devices, creating opportunities for more efficient and automated systems.

IOT is a system of interrelated things, computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers. And the ability to transfer the data over a network requiring human-to-human or human-to-computer interaction.

Four Key Components of IOT

- Device or sensor
- Connectivity
- Data processing
- Interface

Main Components Used in IoT

- **Low-power embedded systems:** Less battery consumption, high performance are the inverse factors that play a significant role during the design of electronic systems.
- **Sensors:** Sensors are the major part of any IoT application. It is a physical device that measures and detects certain physical quantities and converts it into signal which can be provided as an input to processing or control unit for analysis purpose.
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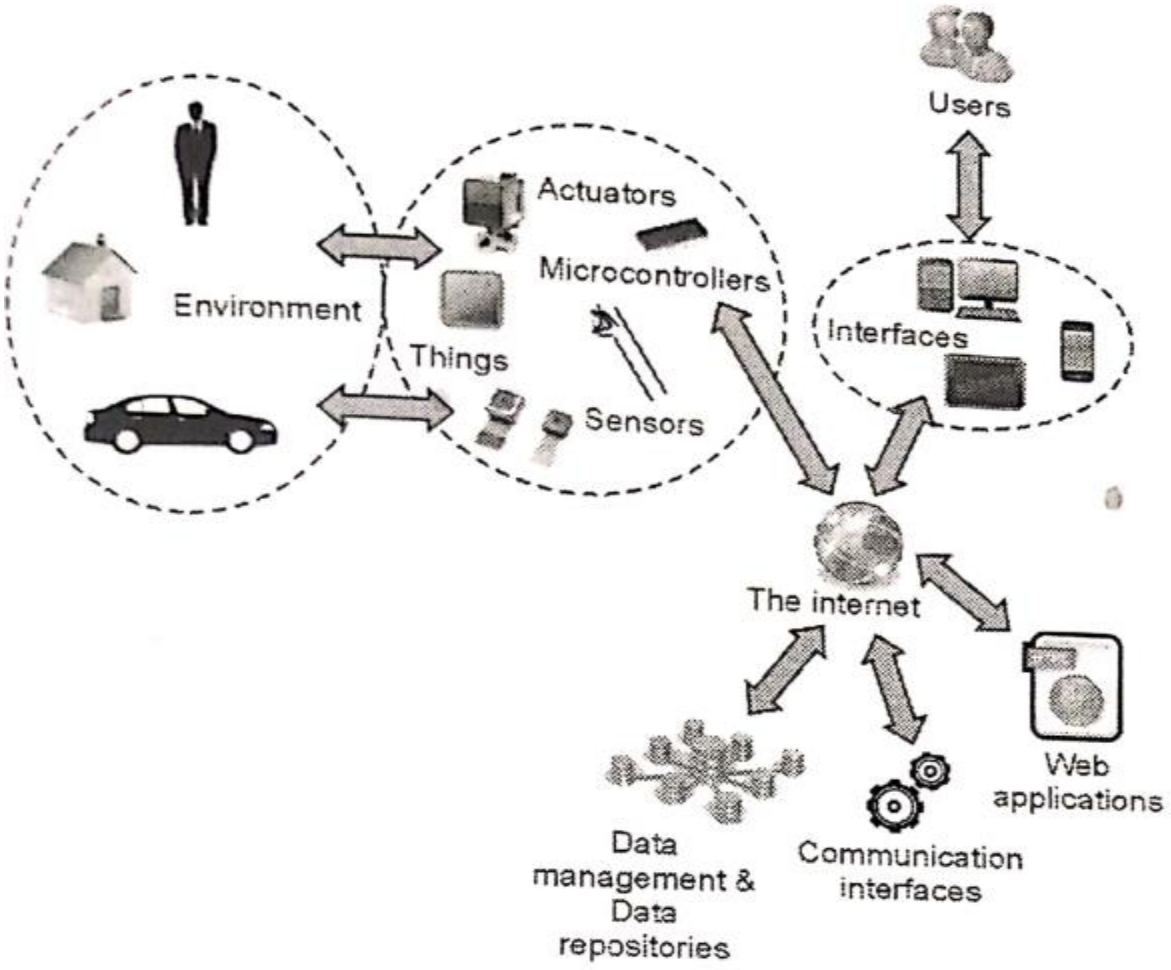
Working with IoT Devices

- **Collect and Transmit Data :** For this purpose sensors are widely used they are used as per requirements in different application areas.
- **Actuate device based on triggers produced by sensors or processing devices:** If certain conditions are satisfied or according to user's requirements if certain trigger is activated then which action to perform that is shown by Actuator devices.

- **Receive Information:** From network devices, users or devices can take certain information also for their analysis and processing purposes.
- **Communication Assistance:** Communication assistance is the phenomenon of communication between 2 networks or communication between 2 or more IoT devices of same or different networks. This can be achieved by different communication protocols like: MQTT, Constrained Application Protocol, ZigBee, FTP, HTTP etc.



Working of IoTac

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 do 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.

Desired Quality of any IoT Application

Interconnectivity

It is the basic first requirement in any IoT infrastructure. Connectivity should be guaranteed from any devices on any network then only devices in a network can communicate with each other.

Heterogeneity

There can be diversity in IoT enabled devices like different hardware and software configuration or different network topologies or connections, but they should connect and interact with each other despite so much heterogeneity.

Dynamic in Nature

IoT devices should dynamically adapt themselves to the changing surroundings like different situations and different prefaces.

Self-adapting and self configuring technology

For example, surveillance camera. It should be flexible to work in different weather conditions and different light situations (morning, afternoon, or night).

Intelligence

Just data collection is not enough in IoT, extraction of knowledge from the generated data is very important. For example, sensors generate data, but that data will only be useful if it is interpreted properly. So intelligence is one of the key characteristics in IoT. Because data interpretation is the major part in any IoT application because without data processing we can't make any insights from data. Hence, big data is also one of the most enabling technologies in IoT field.

Scalability

The number of elements (devices) connected to IoT zones is increasing day by day. Therefore, an IoT setup should be capable of handling the expansion. It can be either expand capability in terms of processing power, storage, etc. as vertical scaling or horizontal scaling by multiplying with easy cloning.

Identity

Each IoT device has a unique identity (e.g., an IP address). This identity is helpful in communication, tracking and to know status of the things. If there is no identification then it will directly affect security and safety of any system because without discrimination we can't identify with whom one network is connected or with whom we have to communicate. So there should be clear and appropriate discrimination technology available between IoT networks and devices.

Safety

Sensitive personal details of a user might be compromised when the devices are connected to the Internet. So data security is a major challenge. This could cause a loss to the user. Equipment in the huge IoT network may also be at risk. Therefore, equipment safety is also critical.

Architecture

It should be hybrid, supporting different manufacturer's products to function in the IoT network.

As a quick note, IoT incorporates trillions of sensors, billions of smart systems, and millions of applications.

Advantages of IoT

- Improved efficiency and automation of tasks.
- Increased convenience and accessibility of information.
- Better monitoring and control of devices and systems.

- Greater ability to gather and analyze data.
- Improved decision-making.
- Cost savings.

Disadvantages of IoT

- Security concerns and potential for hacking or data breaches.
- Privacy issues related to the collection and use of personal data.
- Dependence on technology and potential for system failures.
- Limited standardization and interoperability among devices.
- Complexity and increased maintenance requirements.
- High initial investment costs.
- Limited battery life on some devices.
- Concerns about job displacement due to automation.
- Limited regulation and legal framework for IoT, which can lead to confusion and uncertainty.

Evolution of IoT Over the Years

With the rising adoption of the Internet of Things (IoT), the modern world is becoming broader and faster in terms of connectivity. As we know, IoT refers to the millions of physical devices that are connected to the internet and provides a platform for every industry to foster innovation and productivity. Although the technology is in its infant stage, the potential it holds for businesses is massive and it represents the next evolution of the connected world where it won't be remiss to say that – "Interconnectedness is the new normal."

A Timeline of IoT's Evolution

The evolution of IoT as it stands today began just a few decades ago with the development of ARPANET, the first connected network and the granddad of today's 'Internet'. The history of IoT starts from here and follows a timeline of milestone moments which we will chronicle below:

- 1982 – A graduate student in Carnegie Mellon University's computer science department wants to know if his department's soda vending machine has cold soda bottles but doesn't want to go all the way there to check as the

machine is quite a distance from his classroom. So, with the help of two fellow students and a research engineer, he develops a code that can let anyone on the university ARPANET monitor the status of the vending machine; whether it has soda bottles and whether they are cold or not. The evolution of IoT began here.

- 1989 – English computer scientist Tim Berners Lee proposes the framework of the World Wide Web and lays the foundation of the Internet.
- 1990 – MIT's John Romkey invents a toaster that can be turned on or off via the Internet. It was connected to a computer as there was no Wi-Fi then, but this toaster is considered to be the world's first IoT device – the first 'thing' in the Internet of Things.
- 1993 – Quentin Stafford-Fraser and Paul Jardetzky from the University of Cambridge build the Trojan Room Coffee Pot in their computer laboratory where an image of its interior is uploaded to the building's server thrice every minute for people to check the level of coffee when they want a cup.
- 1999 – Current Executive Director of Auto-ID Labs at MIT, Kevin Ashton, coins the term Internet of Things (IoT) in a presentation he makes at Proctor & Gamble about linking RFIDs in their supply chain to the internet.
- 2003-2004 – The term IoT starts to be used widely in mainstream publications like The Guardian and Scientific American.
- 2005 – The United Nations International Telecommunications Union acknowledges the impact of IoT in its report.
- 2008 – The first IoT conference is held in Zurich, bringing together researchers and practitioners from academia and industry to take part in the sharing of knowledge. In the same year, the US National Intelligence Council recognized IoT as one of the six disruptive civil technologies. The Evolution of IoT gained popularity from this point onwards.
- 2011 – The Cisco Internet Business Solutions Group (CIBSG) announces in their white paper that the true birth of IoT was between 2008 and 2009 where the number of things connected to the internet exceeded the number of people connected to it.
- 2012 and beyond – Companies like Apple and Samsung make waves with their smartphones, there is a proliferation of AI-powered personal assistants like Google Home and Amazon Alexa, we all start to have devices that control individual things in our home, all working in concert with our computers and phones to share data and interact. Today, all our devices work in tandem over the internet

Conclusion

The future seems ripe with a host of endless possibilities which only go to show that the evolution of IoT and the growth of IoT technologies has gone past the point of no return. Technology today not only pushes past barricades we once thought insurmountable but also moves us towards a world where equal access to the internet and its resulting technological marvels will be available to everyone. IoT will continue to evolve in many ways which will amaze and astound us, ultimately creating a truly limitless potential for everyone.