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Internet of Things (IoT)-Definition, Architecture, Applications

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***Abstract*— In this paper, we purse the concept of Internet of Things (IoT) in general, as well as reviewing the architecture and applications. Recently, IoT has crop up which is used to express a modern wireless telecommunication network. Intelligent and interoperability node which is interconnected in a dynamic global infrastructure network can also be called as IoT. In general we can say that IoT is a network where all the physical objects are having a connection with internet using the network devices or routers. Devices made in sense of IoT is said to be a mixture of hardware, software, data and services. This paper also highlights the applications of the IoT.**

Keywords: IoT; Network devices; Architecture

❑INTRODUCTION

Today IoT a major Technology which can be used to produce various internet applications. IoT, a technique which can reduce human effort as well as easy access to physical devices. This technique has a control feature by which any device can be controlled without any human interaction. In the upcoming years, IoT-based technology will offer advancements in power, medicine, agriculture, smart cities, and smart homes.

[1] In 2005. The vision of IoT according to Kevin's vision was to enable networked devices to propagate their information about physical world objects through the web.

IoT simply means the ability to make everything connected to the Internet with an intelligent behavior. IoT contains a large number of variety of objects which can be classified into two types i.e. i) Things are rechargeable things(e.g. Laptop, tablets and mobile phone) and ii) Things are non-rechargeable things.

The idea of IoT is to promote communication from anywhere between anything at anytime via applications. IoT basically relies on RFID (Radio Frequency Identification) and sensor network technologies in the implementations.

Overview of this paper is to define the IoT, its architecture, and the differences between IoT and the traditional Internet.

❑DEFINITION AND HISTORY

The network of smart devices was discussed, with a modified Coke machine in the early 1982. The coke machine was modified at "Carnegie Mellon University" . The coke machine is the first Internet-connected appliance which was having the capability to report its inventory and check whether newly loaded drinks were cold or not.

[2] In 1994 Reza Raji explained the idea of IoT as "small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories".

In 1999 Internet of Things first became popular**. Kevin Ashton a British entrepreneur first used the term (Internet of Things) in 1999 while working at Auto-ID labs**. Besides that near field communication, QR code scanners and digital watermarking, barcode scanners are devices which are recently working on IoT in the present scenario.

[3] Internet of Things = "Sensors and actuators embedded in physical objects are linked through wired and wireless networks, often using the

same Internet Protocol (IP) that connects the Internet."

A system of computing devices which are interrelated with each other that consists of mechanical and digital machines, objects, people or animals that are provided with unique identifiers (UIDs) and their ability to transfer data over a network without requiring human-to-human or human-to-computer interaction .

A. *Abbreviations*

- UIDs - Unique Identifiers
- IP - Internet Protocol
- RFID - Radio Frequency Identification

❑ ARCHITECTURE

Predominantly, IoT architecture consists of various elements i.e. sensors, protocols, cloud services, actuators, and layers. Architecture of Internet of Things is distinguished in layers in order

to track the system consistency. Primarily, IoT architecture consists of three layers:

1. Operators on the server side (IoT Getaway Layer)
2. The client side (IoT Device Layer)
3. A pathway for connecting clients and operators (IoT Platform Layer)

Following are the essential component of 4 Stage IoT architecture:

1. Sensors and actuators
2. Internet getaways and Data Acquisition Systems
3. Edge IT
4. Data center and cloud.

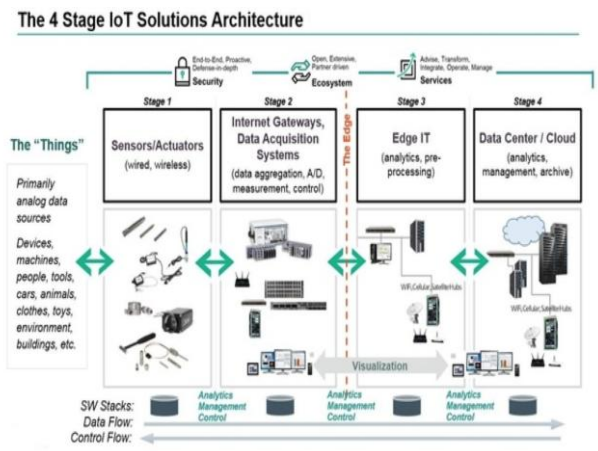

Fig 3.1: [4] Stages of IoT Architecture

The detailed presentation of these stages can be found on the diagram below.

First Layer(sensors/actuators):
The first layer comprises of Sensors which can sense and collect data from the surrounding.Sensors have the ability to convert the information obtained from the outer world into data for analysis The main objective of sensors is to identify other smart objects & pick up of physical parameters.

Actuators can affect a change in the environment. For example, a sensor senses the temperature and light, and thus actuator acts as per the situation.
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Due to this sensing and actuating, this stage covers everything needed in the physical world for the further analysis.

Second Layer(data acquisition system):
Then comes the layer where the data is received in analog form which is afterwards converted to digital form.This layer do it exactly with the help of internet gateway that's why this layer is also known as Internet Gateway Layer. For the collection pre-processing in real time both the above layers are situated closely. Gateways can also provide for additional functionalities such as data management, protection against malware, and analytics.
The main objective of this stage is to process a large amount of information collected and squeeze it to the optimal size for further analysis. In essence, this stage makes data aggregated and digitalized.

Third Layer(edge IT):
The above layers are situated at actual location of device but this layer is situated at edge locations or at remote offices. In general , data from the IoT is so gigantic that, if directly sent to the data center or server, it will out to lunch a large amount of network bandwidth, overburden your resources. Thus, the systems present at the edge perform the analytics to alleviate the burden on core IT infrastructure.

Fourth Layer(cloud analytics):

The main processes on the last stage of IoT architecture may take place on-premise, in the Cloud, or in a Hybrid Cloud System. Here data is processed in depth. Precisely, to ensure an in-depth analysis, data from other sources is also incorporated.

After this in-depth analysis all the information is brought back to the physical world.The data brought to this world is in a highly processed and precisely analyzed manner.

The future of IoT architecture strive for the connection between real-world, cyber-world and social world.

❑ DIFFERENCE BETWEEN IOT AND TRADITIONAL NETWORK

IoT technology has started a new era of telecommunication technology. IoT could also be understood as expansion of network which is based on Internet but different from the traditional network and WSN.

"IoT environment= Internet + WSN"

This equation expresses the IoT environment. e 1. Evolution of M2M (Machine to Machine) model is IoT. From the previous knowledge of the IoT environment we can say that IoT does not use IP in all cases for addressing things, because IoT needs lightweight communication protocols. When working with smart little things the complexity of TCP/IP protocol is not suitable in particular environment. The IoT environment is grounded on connected smart objects. Entrenched on these arguments, the previous statement can be corrected and said

"IoT= Internet + WSN + Smart Items surrounded by Intelligent environment."

To ensure the existence of a minimum level of the previously mentioned elements within the network we have one of the way which is called as intelligent environment. In IoT, devices can directly talk to each other, exchange data between devices, and make joint decisions without the need for servers.

Interoperability, self- configuration, self- adaptive and self-protection are the feature supported by IoT.

Table 1. The similarities and differences between IoT, Internet, and WSN

Characteristics	**Internet**	**WSN**	**IoT**
Node type	Active	Active	Active\Passive
Design of the network	Set of networks contains set of Fixed objects	Dynamic smart objects	WSN+ dynamic smart things+ Internet surrounded by intelligent environment
Area covered	wide area covered	wide area covered	local area covered
Communication protocol	TCP\IP	Lightweight communication protocol	Lightweight communication protocol
Behavior	Fixed	Dynamically	Dynamically
Networking Time	Unlimited	Unlimited	Timing Synchronization

❑ APPLICATIONS

On top of that there are so many applications which have turned up to serve the IoT concept. IoT technology has touched so many aspects of our daily lives such as healthcare, smart water, transportation and so on and has made our lives congenial. IoT applications can be categorized into four categories:

i) **Personal and home uses** (Most popular example of this category is healthcare sector)

ii) **Enterprise** (Common example of this category is video surveillance followed by smart home and smart environment generally)
iii) **Mobile** (The popular example of this category is transportation)
iv) **Utilities** (The best example of this category is smart metering, smart grid, and smart water and quality of drinking water)

Most popular examples of each category are mentioned below:

Healthcare:
Medical researchers uses leftover data, controlled environments, and volunteers for medical examination. The resources used by these researchers lack in critical real-world information. IoT unscrews sea of valuable data through testing, real-time field data, and analysis. Power, precision, and availability of current devices can be improved with the help of Internet of Things.

Smart environment (i.e. Smart city, smart home):. A smart environment means smart lightning, smart parking, Smart Waste Management, Smart Traffic Management system. A smart environment analyzes the changing data patterns in real life aside from this it also reads live data. A smart environment has a dynamic relationship among the surrounding rather than a simple transactional relationship.

Automotive and smart mobility:
Efficiency and management capabilities of vehicles are going on increasing day by day which is ascribed to IoT. To provide in-car navigation, telematics, and entertainment smart apps are being baked into car infotainment systems. Vehicles integrated with sensors in the operational components of vehicles can monitor functional metrics and forecast performance benchmarks.

Smart energy and smart grid:Power consumption is the biggest problem in the sensors where battery of sensors may drain very expeditiously. Energy distribution and consumption in heterogeneous environments are managed by Cloud computing and IoT.

❑ CONCLUSION AND FUTURE DIRECTION

IoT is one of the main techniques, but still it is not much popular like the cloud computing technology. The future of the IoT structure hinge on the integration between real world, cyber-world and social world. This paper has also reviewed the differences between both IoT and the traditional network. Lastly paper reviewed plunk of popular applications which are offered by IoT such as healthcare, smart cities, smart grid, smart transportation, etc.. Based on the above, IoT environment can be said as rich search and flourishing area to research in particular in integration with cloud computing.

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