International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 6 Issue 4, April-2017

Internet of Things: Architecture, Applications and Future Challenges

Vipin Kumar Rathi[1], Sahil Pathak[2], Ankur[3]

[1,2]Ramanujan College, University of Delhi, Delhi, India
[3]NIT Delhi, Delhi, India

ABSTRACT

In this paper, a brief survey about Internet of Things is presented. Internet of Things added the new dimension in the word of Information and Technology sector. There are thousands of challenges in IoT which is a collection of billions, trillions of Things. IoT provides a way to immediately access the information about the physical object and their surroundings. Different layered architecture such as sensor connectivity layer, gateway layer, management and application layer are discussed. Some IoT application and challenges are mentioned in the later part.

Keywords: IoT, RFID, Sensors, Security, Quality of service.

1. INTRODUCTION

The Internet of Things (IoT) is gaining attention from last few years; the basic idea behind this concept is increasing variety of things around us like RFID tags, sensors, actuators, smart devices etc. We need a mechanism to connect these devices or things and efficiently exchange information between them to achieve common goals. The term Internet of Things was discovered by Kelvin Aston in 1999[1]. IoT allow people and things to communicate anytime, anywhere and anyplace. With the combination of both the advanced technologies in hardware and software, the Internet of Things is able to track and count everything which can greatly reduce the waste, lost and cost. The information of parameters of internet can simply obtained at fingertips using electronic devices which ease the user to take further action.

Usage of IoT is increasing day by day.In 2003,500 million devices are connected to Internet, while Population of world was 6.3billions.By 2010 Population was 6.8billion,while the number of devices connected to internet increased to 12.5 billion. By 2015 world's population will be about 7.2 billion, but the number of devices connected will be about 25 billion. By 2020 it is estimated that connected devices will be about 50 billion that will be 4 times of world's population. It shows the expansion of IoT in the world and dependability on IoT [2].

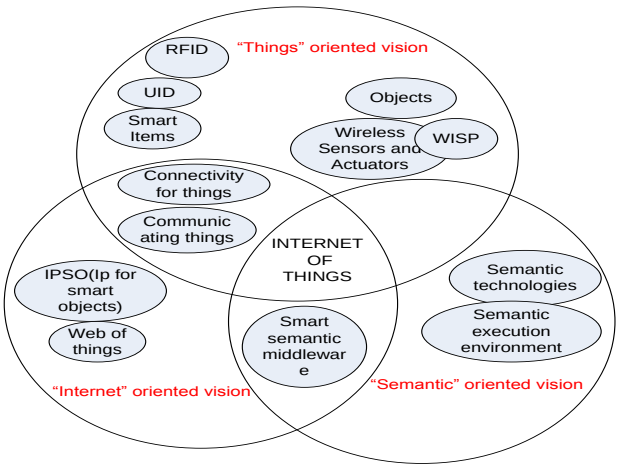

Fig [1] Internet of Things paradigm for different visions

Today some massive global internet that allow people to communicate each other, we send email, we send instant messages, we use websites to communicate to share data and It's the people who drive the Internet. The data we sent come from client devices like laptops, PCs, tablets, smart devices etc. and that goes to server than server transfer that

data or information further in that sense we can say, Internet is made-up of three things i.e. people, client device and the server. But all of these categories actively are being added to the Internet and they have been called Things in the terms IOT. Things is any object that has a sensor attached to it that can transmit the data from that sensors further to the Internet or to the cloud where we can analysis and use to make decision. Sensors include temperature sensors, traffic sensors, flow rate sensors and energy monitor usage as a server. A temperature sensor can be placed in a smart thermostat, a smart usage electricity meter can be wired into a house or a traffic monitor can be place into a traffic signals. These things can further send the data to the chain either a person or a piece of computer software to make decision based on that data.

2. IOT ARCHITECTURE

Architecture of Internet of Things is comprises of different technology suits that make works as a complete system. It includes different layers: Sensor connectivity layer, Gateway Network layer, Management service layer, application layer are discussed below.

a.) Sensor connectivity layer: It consists of large number of smart devices which is embedded with sensing capabilities. It is connected with the physical world and transmits the information to the digital world so that the data can be processed and analyzed. We have a range of sensors devices i.e. GPS, electrochemical, photo electric, gyroscopes etc along with that this layer includes RFID tags and barcodes to uniquely identify those devices. These devices perform various activities like temperature & humidity sensing, air quality, heart monitoring etc.

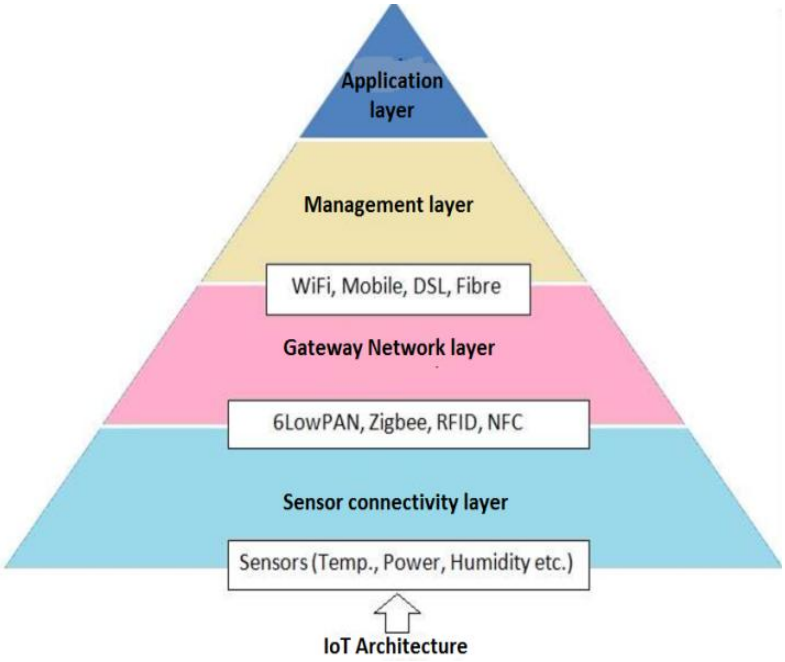

Fig [2] IoT Architecture

b.) Gateway Network layer: this layer provides the interface between the sensor hub and Internet/cloud. The data which is collected through sensors will transmit to the centralized hub and then further forward to the Internet using gateway network. The gateway Implementation is of two type:

- **Simple Gateway:** It organizes the data and converts into the packet so that it can be transfer to the Internet for the analytics of data.
- **Embedded control Gateways:** It extends the functionality of simple Gateway by adding resources processing and intelligent handling. It provides interoperability between devices.

c.) Management layer: this layer helps the developers to work with heterogeneous devices without considering there hardware platform.

c.) Application layer: This layer provides the end user interface to interact with the IoT devices. It provides high quality services to their users [4].

3. APPLICATIONS OF IOT

a.) Smarts City:

- **Smart bins:** IoT based Smart bins uses the sensors to provide the status of the fill level and generate the alerts to the nearby trucks when the bin is about to full GPS enabled truck are routed optimally to the pickup location to collect the garbage. These bins are connected through underground pipes to suck the wet garbage. Information generated by these sensors is stored on cloud and later use these information via mobile or Web to predict waste generation pattern and make arrangements in advance to avoid unpredicted waste accumulation. In this way it benefits to avoid pollution, improve efficiency through real-time monitoring and provide clean & green neighborhood environment.

- **Smart parking system:** In the smart car parking system the mobile application that shows the all nearby parking. These parking areas uses the sensors to communicate to the mobile application to let the user know how many parking slots are available where he can park and reduces the number automatically. It benefits to save time, fuel and provide easy payment options.

- **Smart streetlight:** It uses the movement detection sensors or weather sensors to vary the intensity of light, when traffic is low using these sensors it detect malfunctioning of light as well as notify the service station. Sensors and cameras detect road condition, congestion and accidents, which help to update the maps to suggest alternative route, display the message on the signboards accordingly and inform the nearest help center.

- **Smart transportation:** A big screen is located near the bus station which shows a map with the details of buses in this route, display details of particular route number, status of next bus arrival, number of seats available and fair details, use the smart card for the payment. This information can also be accessed through mobile application. It benefits in term of less traffic jam, less fuel consumption, improve road safety, smooth traffic flow and convenient for both vehicles and pedestrians commuters.

b.) Healthcare

IoT provides various applications in medical field. Sensors attached to patient's body monitor various health parameters such as breathing activity, body temperature ,blood pressure ,calories consumed by body etc. and these information is forwarded health centers. Wearable sensors (gyroscopes, accelerometers) with various applications running on computing devices enable person to analyze daily activities like exercises done, calories consumed etc. so that they can improve their lifestyle and prevent health problems.

c.) Agriculture

Smart agriculture system saves water and improving the crop yields using different sensors. The Agriculture harvesters use a lots of automated control system which are sensors based. They separate grains from the main stalk and directly put it in a vehicle for transport. Once the grains are stored at warehouses it has to be monitored for bugs/ insects. Warehouse monitoring systems scan for insects and send the alerts to the user. They also monitor and control temperature, moisture and air quality in the warehouse.

d). Smart home automation

IOT is a better way to manage the house resources by using advanced IoT technology. The key part is played by the sensors, which are used to monitor the resource utilization as well as reorganize the current user needs. It provides the better way to use home electronic equipment like refrigerator, air conditioner, washing machine, coffee maker, television etc. In that way it helps to reduce the expenditure and mange wastage of electricity.

e.) Environmental monitoring

IoT technologies enable the monitoring and decision support system. Fire detection is an IoT device that supports the environment safety by using its sensing its sensing abilities. Temperature sensors are used t sense the presence of fire and an alarm is set which directly informs the fire department in a short period of time along with the parameters that help in decision making so, that they can take appropriate action at right time.

f.) Smart Business/Inventory and product Management:

In many sectors for Inventory Management the RFID technology is used to track and identify the product from supply to delivery chain. The RFID tags are placed on the containers so that the reader can fetch the appropriate information. In Retail, with the help of IoT Technology we can monitor real-timeproduct availability and maintain stock inventory. It plays an important role after market support where user can retrieve the data related to product they bought.

g.) Security and Surveillance:

Now these days the Security surveillance are visible on most of the places like Enterprise buildings, shopping malls, car parking factory floor , jewelers shop, highways, Roads etc. The presence of dangerous chemical can be sensed by ambient sensors. Behavior of people can also be monitor using sensor which help to identify the suspect [3].

4. CHALLENGES IN INTERNET OF THINGS

Heterogeneity of devices: Devices those communicate with each other contains different functionalities, computational capabilities and applications.

Scalability: The number of sensor nodes deployed in the sensing area may be in the order of hundreds, thousands or more and routing schemes must be scalable enough to respond to events [5].

Devices limitation: Devices are limited for batteries life, processing power and memory. Soenergy harvesting technique is used to improve energy limitation of devices.

Self-configuration and self-organization capability: To minimize human intervention devices should be able to react autonomously in different situations. So that devices can handle interference management and end to end communication [6].

Security: For adopting IoT technologies and applications at wider level security is considered as a main component. It contains data confidentiality, privacy, authentication and integrity. Where data confidentiality means that data accessing and data modification can be done by only authorized users and objects. Privacy defines the rules under which users can accessed the data.

Quality of service (QoS): The quality of service means the quality service required by the application, it could be the length of lifetime, the data reliability, energy efficiency, location-awareness and bandwidth utilization. In some applications (e.g. some military applications) the data should be delivered within a certain period of time from the moment it is sensed [7].

Cloud computing: To make IoT more effective and to make wider IoT applications, cloud computing provides dynamic way of gathering and storing data. It offers different services such as infrastructure as a service(IaaS),platform as a service(PaaS) and software as a service(Saas).

New protocols: In IoT, protocols play important role in complete realization. Protocols work as a medium between sensors and physical world for data intelligence. There are various existing Mac protocols and routing protocols but they are not so efficient for bandwidth utilization, energy optimization, delay minimization while using in IoT ecosystem.

CONCLUSION

In recent year, IoT is gained a lot of attention in IT sector. This paper is discussing about the concepts of IOT in day to day life. Different IoT layered architecture is discussed i.e. sensor connectivity layer, gateway network layer, management layer and application layer and how these layer help to connect heterogeneous device to communicate each other. IoT applications are mentioned and how it helps to make our daily life easy and comfortable. Finally, some IoT challenges are highlighted and discussed.

REFERENCES

[1]. Bello, O.; Zeadally, S: "Intelligent Device Communication in the Internet of Things," Systems Journal,IEEE,Vol.1,no.99,pp.1-11,2014.
[2]. D. Evans, "The Internet of things: How the next evolution of the Internetis changing everything," Cisco IBSG, San Francisco, CA, USA, 2011.
[3]. Miorandi, D.; Sicari, S.; Pellegrini, F.; Chlamtac, I: "Internet of Things: Vision, applications and research challenges," Adhoc NetworkELSEVIER,Vol.29,no.7,pp.1497-1516,2012
[4]. Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of things: A survey on enabling technologies, protocols, and applications. IEEE Communications Surveys & Tutorials, 17(4), 2347-2376.
[5]. Haykin,S: "Cognitive radio: brain-empowered wireless communications," Selected Areas in Communications, IEEE Journal on, Vol.23,no.2,pp.201–220,2003.
[6]. Chlamtac, I; Conti, M; Liu, J.J.-N:" Mobile ad hoc networking: imperatives and Challenges, "Ad Hoc Network, ELSEVIER,Vol.1,no.1,pp.13–64,2003.
[7]. El-Sayed, H; Mellouk, A; George, L; Zeadally,S: " Quality of service models for heterogeneous networks: overview and challenges," Annals of Telecommunications,SPRINGER,Vol.63,no.11,pp.639–668,2008.