International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

A Review Paper on Internet of Things (IoT) and it's Applications

Mrs. Sarika A. Korade[1], Dr. Vinit Kotak[2], Mrs. Asha Durafe[3]

[1]*Student, Dept. of Electronics Engineering, SAKEC, Chembur, Mumbai, Maharashtra, India*
[2]*Professor, Dept. of Electronics Engineering, SAKEC, Chembur, Mumbai, Maharashtra, India*
[3]*Professor, Dept. of Electronics Engineering, SAKEC, Chembur, Mumbai, Maharashtra, India*

---***---

Abstract - *Internet, a revolutionary invention, is always transforming into some new kind of hardware and software making it unpreventable for anyone. The type of communication that we see today is either human-to-human or human-to-device, but the Internet of Things (IoT) promises a great future for the internet where the type of communication is machine-to-machine (M2M). The Internet of Things (IoT) is defined as a paradigm in which objects provide with sensors, actuators, and processors communicate with each other to serve a meaningful purpose. In this paper we discussed IoT and its architecture. Further we explained different applications of IoT for users, IoT advantages and disadvantages.*

Key Words: **IoT, Edge Computing, Field Protocol, Cloud Protocol, Smart City, Smart Grid, Smart Health, Smart Farming**

1. INTRODUCTION

Evolution of internet began by connecting computers. Later many computers were connected together which created World Wide Web. Then mobile devices were able to connect to the internet which leads to mobile-Internet technique. People started using the internet via social networks. Finally the idea of connecting daily objects to the internet was proposed, which lead to the Internet of Things technology [1].

The Internet of Things term is coined by Kevin Ashton executive director of the Auto-ID Center. The concept of IoT first became very popular through the Auto-ID Centre in 2003 and in related market analytics and it's publications[2]. When the concept of such communication came into existence, different companies focused on it and tried to recognize its significance and began to identify its role and the correlated future aspects, then these companies started investing in the domain of IOT in different periods but at regular intervals of time[3].

1.1 Definition of IoT

If we want to define IOT then we cannot define it precisely and concisely but Vermesan et al. defined the Internet of Things as simply an interaction between the physical and digital worlds. The digital world interacts with the physical world using a plethora of sensors and actuators [4].

IoT can also be defined as "An open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment"[5].
Current research on Internet of Things (IoT) mainly focuses on how to enable general objects to see, hear, and smell the physical world for themselves, and make them connected to share the observations. In that sense, monitoring and decision making can be moved from the human side to the machine side.

So in general we can say IoT allows people and things to be connected Anytime, Anyplace, with anything and anyone using any network and any service as shown in Fig-1.

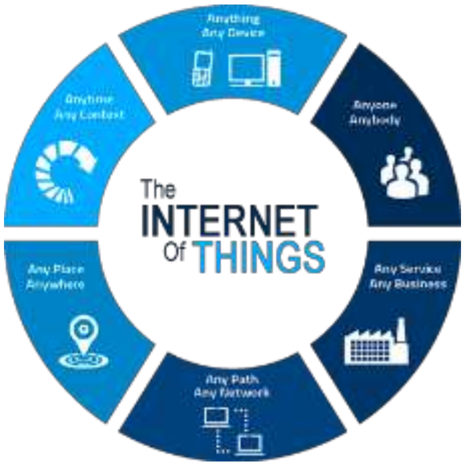

Fig -1: Definition of IoT

2. THE IOT ARCHITECTURE

Fig-2 Shows main components of this architecture i.e. edge side and cloud side.

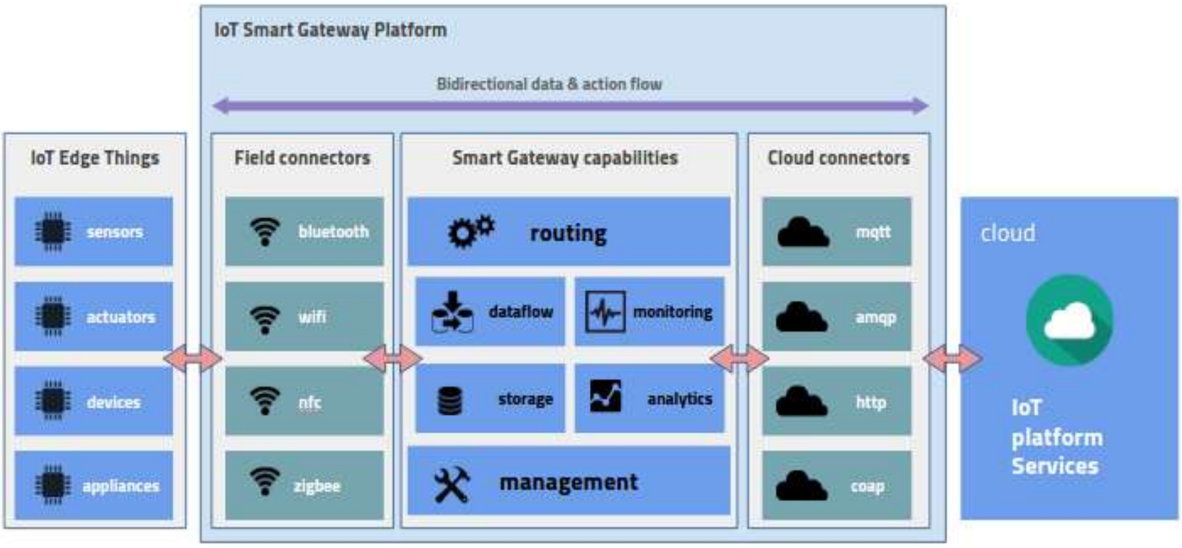

Fig-2 : The IoT Architecture

2.1 The Edge Things

In the edge side the things could be sensors, actuators, devices and a significant thing called gateway. The important function of this gateway is to establish communications between things and cloud services and also manage the actions between the things. The term edge come from [6] Edge Computing where data are processed at the periphery of the network, as close to the originating data as possible. The edge can be smart city, smart building, a manufacturing floor, energy grid, oil rig, wind farm, dairy farm, planes, trains or automobiles. The key element which makes the edge processing significant is to turn on the data processing and action taking the most close to real-time.

2.2 Field Protocols

As sensors, actuators and devices are present at the edge, they must communicate with each other and also with Smart Gateway. This type of communication are based on field protocols, the most popular protocols are:

Bluetooth: It is a significant protocol for IoT applications. It has been designed to offer significantly reduced power consumption. Standard: Bluetooth 4.2 core specification, Frequency: 2.4GHz (ISM), Range: 50-150m (Smart/BLE), Data Rates: 1Mbps (Smart/BLE)[7].

Zigbee: Similar to Bluetooth, it has a large installed base of operation, although perhaps traditionally more in industrial settings. ZigBee PRO and ZigBee Remote Control (RF4CE), among other available ZigBee profiles, are based on the IEEE802.15.4 protocol, which is an industry-standard wireless networking technology operating at 2.4GHz targeting applications that need comparatively unusual information exchanges at low data-rates over a restricted area and within a 100m range such as in a home or building[7].

Wi-fi: This type is often a distinct choice for many developers, especially given the ubiquitous of Wi-Fi within the home environment within LANs. It offers fast data transfer and the ability to handle high quantities of data[7].

NFC: Near Field Communication (NFC) is a technology that enables simple and safe two-way communication between electronic devices, and especially applicable for smartphones, allowing consumers to perform contactless payment transactions, access digital content and connect electronic devices. Essentially it extends the capability of contactless card technology and enables devices to share information at a distance that is less than 4cm[7].

2.3 IoT Smart Gateway

A main capability of IoT Gateway is enabling communication from the Edge to the Cloud. It means it must understand field protocols and convert it to cloud protocols. Smart Gateway has the capabilities such as routing, Dataflow, management of data, monitoring of data and storage of data[8].

2.4 Cloud Protocols

The most of IoT solutions, even those ones live almost entirely on the edge need to integrate with cloud services or other IoT solution based on cloud. We need to communicate using a cloud protocol as listed below:

MQTT: Message Queue Telemetry Transport (MQTT) was introduced by IBM in 1999 and standardized by OASIS in 2013 . MQTT is frequently used and supported by embedded devices, and is also common in machine-to-machine interactions. It is designed to provide embedded connectivity between applications and middle wares on one side and networks and communications on the other side[9].

AMQP: The Advanced Message Queuing Protocol (AMQP) is a protocol that was designed for financial industry. It runs over TCP and provides a publish/ subscribe architecture which is similar to that of MQTT. The difference is that the broker is divided into two main components: exchange and queues. The exchange is responsible for receiving publisher messages and distributing them to queues based on pre-defined roles and conditions. Queues basically represent the topics and subscribed by subscribers which will get the sensory data whenever they are available in the queue[9].

CoAP: The Constrained Application Protocol (CoAP) is another session layer protocol designed by IETF Constrained Resurce Environment working group to provide lightweight RESTful (HTTP) interface. Representational State Transfer (REST) is the standard interface between HTTP client and servers. However, for lightweight applications such as IoT, REST could result in significant overhead and power consumption. CoAP is a document transfer protocol. CoAP is designed to enable low-power sensors to use RESTful services while meeting their power constraints. It is built over UDP, instead of TCP commonly used in HTTP and has a light mechanism to provide reliability. CoAP architecture is divided into two main sublayers: messaging and request/response. The messaging sublayer is responsible for reliability and duplication of messages while the request/response sublayer is responsible for communication. As in HTTP, CoAP uses GET, PUT, PUSH, DELETE messages requests to retrieve, create, update, and delete, respectively[9].

HTTP: HTTP is a "connectionless" protocol. With the HTTP bridge, devices do not maintain a connection to Cloud IoT Core. Instead, they send requests and receive responses. This is the standard protocol for web services and still will be using in IoT solutions. The overhead of this protocol is well known but we will continue use of this protocol in some case when latency and bandwidth are not issues[9].

3. USE OF IoT IN VARIOUS APPLICATIONS

Most of the daily life applications are already smart but they are unable to communicate with each other and to enable them to communicate with each other and share useful information with each other will create a wide range of innovative applications [10]. These emerging applications with some autonomous capabilities would certainly improve the quality of our lives, all due to the concept of IoT. In this section, we present few of IoT applications as shown in Fig-3.

Fig-3 : Applications of IoT

3.1 IoT For Smart Home/Building

Now a days, smart home is becoming a need of fast life. Smart home allows many household devices to be connected with internet for the communication. In smart home, the various home equipment's like air conditioning, doors, windows, lighting, washing machine, and refrigerator can be controlled manually as shown in Fig-4. IoT in integration with wireless sensor network can give intelligent solution for energy management of buildings. With the help of laptop or smartphones, we can access energy information and control system of buildings[11].

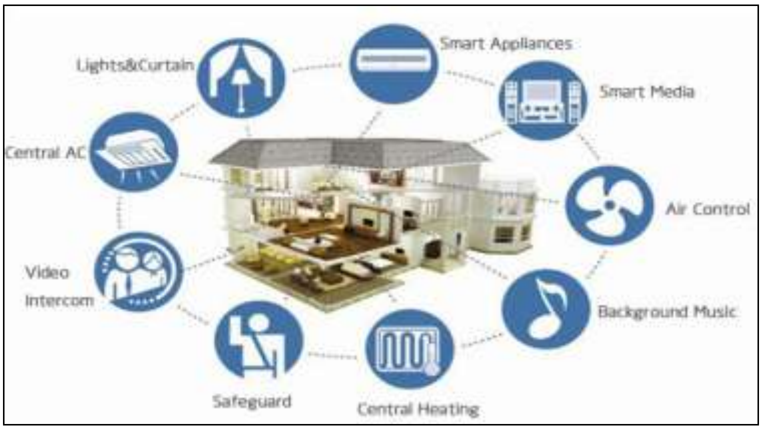

Fig-4: Smart Home

3.2 IoT for Smart Farming

IoT-based smart farming systems can help monitor, for instance, light, temperature, humidity, rain prediction and soil moisture of crop fields using connected sensors as shown in Fig-5. IoT is also instrumental in automating irrigation systems. The benefits of smart farming are it increases the business efficiency through process automation, Enhances product quality and volumes, increases control over the production, Monitoring of climate conditions, Crop management. It also provides better control over the internal processes and lower production risks.

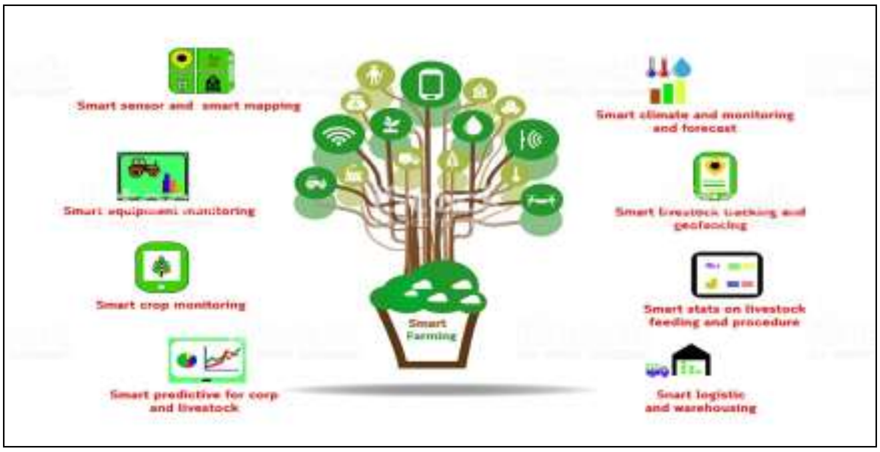

Fig-5: Smart Farming

3.3 IoT For Smart Health

A constant attention is required to hospitalized patients whose physiological status should be monitored continuously can be constantly done by using IoT monitoring technologies. For smart health sensors are used to collect complete physiological information and uses gateways and the cloud to analyse and store the information and then send the analysed data wirelessly to care givers for further analysis and review [12]. It replaces the process of having a health professional come by at regular intervals to check the patient's vital signs, instead providing a continuous automated flow of information. In this way, it simultaneously improves the quality of care through continuous attention and lowers the cost of care in addition to data collection and analysis as shown in Fig-6.

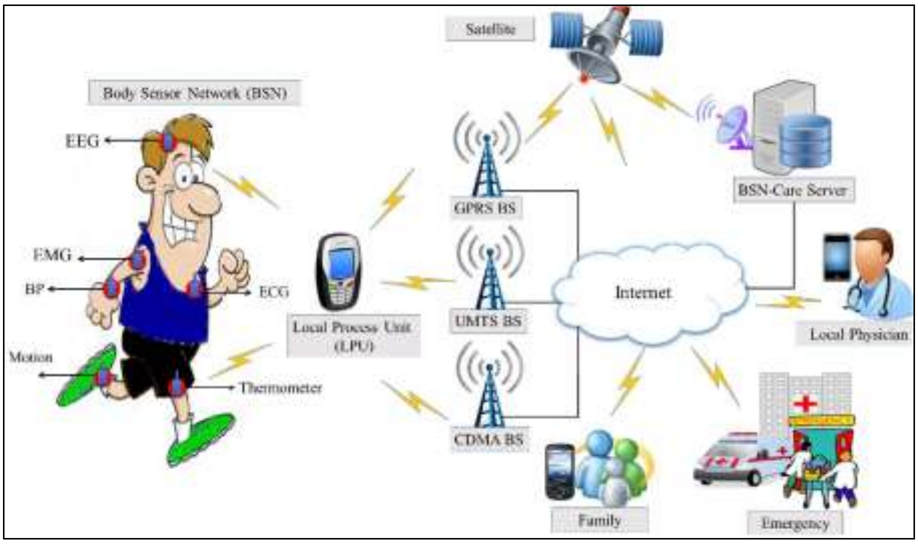

Fig-6: Smart Healthcare

3.4 IoT for Smart City

Smart cities need careful planning in every step, with support of agreement from governments, citizens toimplement the internet of things technology in every aspects. Using IoT, cities can be improved in many ways, by improving infrastructure, enhancing public transportation by reducing traffic congestion, and keeping citizens safe and healthy[13].Smart city layout is shown in Fig-7.

Fig-7: Smart City

3.5 IoT for Smart Energy and The Smart Grid

A smart grid that combine the information and communications technologies (ICTs) to the electricity network will enable a real time, two way communication between suppliers and consumers. It creates more dynamic interaction on energy flow and that will help to deliver electricity more efficiently and sustainably [14]. The significant elements of information and communications technologies will consist of sensing and monitoring technologies for power flows; digital communications infrastructure to transmit data across the grid; smart meters within home display to inform energy usage; coordination, control and automation systems to aggregate and process various information, and to create a highly interactive, responsive electricity [15]. Many applications can be possible due to the internet of things for smart grids, such as industrial, solar power, nuclear power, vehicles, hospitals and cities power control. Fig-8 shows the most important application may be enabled by the internet of things as in smart grid aspect.

Fig-8: Smart Grid

4. ADVANTAGES AND DISADVANTAGES OF IoT

This section mention advantages and disadvantages of IoT Applications.

4.1 Advantages of IoT Applications:

- Security: You can monitor your home using your mobile phones, with the ability to control it. It can provide personal safety.
- Stay connected: You and your family members can always be in the network. You can virtually stay connected.
- Efficient use of electricity and energy: If your home appliances are communicating with you about the work done, their maintenance and repair will be easy. If appliances can operate by themselves then electricity utilization will be possible by an efficient way.
- Best Health Care and Management: The patient monitoring is possible on a real time basis without doctor's visit and also enables them to make decisions as well as offer treatment when emergency is there.
- Cost- Effective Business Operations: A large number of business operations like shipping and location, security, asset tracking and inventory control, individual order tracking, customer management, personalized marketing & sales operations etc. can be done efficiently with a proper tracking system using IoT .

4.2 Disadvantages of IoT Applications

- Privacy issues: Hackers can break into the system and possibility of stealing the data.
- Becoming Indolent: People are more habituated to have a click based work making them lazy to any sort of physical activity, applied science in their daily routine.
- Unemployment: Lower level people like unskilled labour may have high risks of losing their jobs.

5. CONCLUSION

IoT has been gradually bringing a sea of technological changes in our daily lives, which in turn helps to making our life simpler and more comfortable, through various technologies and applications. There are countless applications of IoT into all the domains including medical, manufacturing, industrial, transportation, education, governance, mining, habitat etc. Uses of IoT in various applications are described in this paper. In present and in future also, IoT is on the way of making the human's life as a 'connected' and 'smart' one.

REFERENCES

[1] Charith Perera , Chi Harold Liu, Srimal Jayawardena— The Emerging Internet of Things market place From an Industrial Perspective: A Survey", IEEE transactions on emerging topics in computing||, 31 Jan 2015.
[2] A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari, and M. Ayyash, "Internet of things: A survey on enabling technologies, protocols, and applications," IEEE Communications Surveys & Tutorials, vol. 17, pp. 2347-2376, 2015.
[3] Luigi A., Antonio I., Giacomo M. 2010.The Internet of Things: A survey. Science Direct journal of Computer Networks, Volume 54, Pages: 2787–2805.
[4] Miao W., Ting L., Fei L., ling S., Hui D., 2010. Research on the architecture of Internet of things. IEEE International Conference on Advanced Computer Theory and Engineering (ICACTE), Sichuan province, China, Pages: 484-487.
[5] Ms.Neha Kamdar, Vinita Sharma, Sudhanshu Nayak, "A Survey paper on RFID Technology, its Applications and Classification of Security/Privacy Attacks and Solutions,"IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS), ISSN: 2249-9555 Vol.6, No4, July-August 2016.
[6] Edge computing - http://searchdatacenter.techtarget.com/definition/edge-computing
[7] IoT Protocols - https://www.rs-online.com/designspark/eleven-internet-of-things-iot-protocols-you-need-to-know-about
[8] The Architecture of IoT Gateways - https://dzone.com/articles/iot-gateways-and-architecture
[9] Internet of Things Protocols and Standards -http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/
[10] Tadapaneni, N. R. (2019). Role of Fog Computing in the Internet of Things. International Journal of Scientific Research and Engineering Trends.
[11] R. Abdmeziem, D.Tandjaoui, "Internet of Things: Concept,Building blocks, Applications and Challenges,Computersand Society, Cornell University
[12] Mohammed ZKA, Elmustafa SAA. Internet of Things Applications, Challenges and Related Future Technologies. World Scientific News. 2017; 67(2):126–48.

[13] David Niewolny. How the Internet of Things Is Revolutionizing Healthcare. https://cache.freescale.com/files/corporate/doc/white_paper/IOTREVHEALCARWP.pdf

[14] Eiman Al Nuaimi1 et al., Applications of big data to smart cities. Journal of Internet Services and Applications 2015.

[15] Smart Grid enabling energy efficiency and low-carbon transition, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/321852/Policy_Factsheet_-

[16] C. Pvandana, Chikkamannur(2016). A Internet of Things future in Edge Computing. International Journal of Advanced Engineering Research and Science

[17] Ramyar Rashed Mohassel et al., A survey on Advanced Metering Infrastructure. International Journal of Electrical Power & Energy Systems 63 (2014) 473-484.

[18] Chauhan, S., & Vermani, S. (2016). Shift from Cloud Computing to Fog Computing. Journal of Applied Computing, 1(1), 25-29.