The Technologies That Plays A Vital Role In Developing Internet of Things

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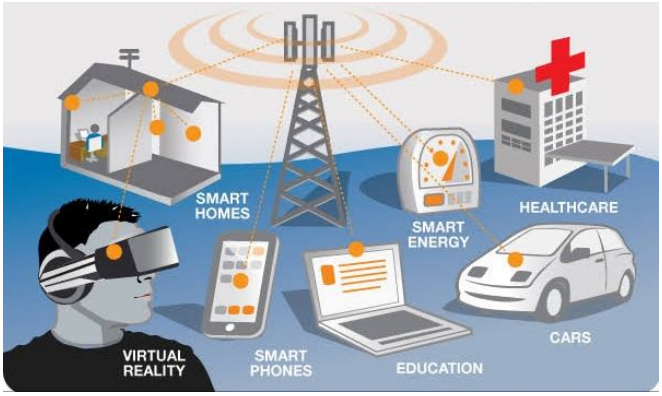
Abstract- *Internet of Things extended the usage of internet. Any device connected with the internet is able to acquire the concept of "Internet of Things". The IoT is considered as the network of connected things and people. The technologies that plays a essential role in the development of the application IoT including 5G, cloud computing, semantic web and cognitive radio. 5G is abbreviated as fifth generation that supports IoT with higher speed and lower latency. 5G provides huge application in the field of IoT, for example artificial intelligence and advanced virtual reality. It paved the way for the better future with the technology of Internet of Things. Cloud computing is the process of accessing data and storing in the centralized pool of computing resource that can be ordered and consumed on demand. The Semantic Web is a network of data that is associated in such a way that it reduces human operators and they can easily be processed by machines. It is considered as an extension of the existing World Wide Web. Cognitive radio is considered as one of the new long term developments that taking place, radio receiver and radio communication technology. 'Cognitive internet of things' interacts a physical environment with minimum human interaction.*

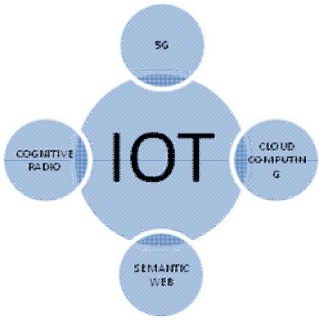
Keywords- Internet of Things, 5G, cloud computing, semantic web, cognitive radio

I. INTRODUCTION

IoT (Internet of Things) is the new communication model that will extend the usage of current Internet by providing communication through Machine to Machine (M2M) interaction. In recent days, the Internet connected devices (such as computers, tablets and mobile phones) were controlled by humans directly. IoT provides the platform for connecting the physical objects that are accessible through Internet. The word 'thing' in IoT refers to a person with an automobile along with build-in-sensors, i.e., object with an IP address and have the capability to transfer the data over Internet without manual interaction. The embedded technology, that is available in the objects will help to interact with the internal states or the external environment, which effects the decision taken, that includes an extraordinary number of objects like self-driving cars, in which the complex sensors detect objects in their path, smart microwaves, which automatically cook your food in the right length of time, wearable fitness devices that measure your heart rate and the number of steps you've taken the whole day, this helps to lead the life with proper health, and these information are used to suggest exercise plans that fits you. Even connected footballs are connected that can track how far and fast they are thrown and record those statistics for future training purposes.



The diagrammatic representation of technology of Internet of Things is presented in the following diagram:



The above diagram shows the integration of current and future enabling technologies with IoT. These include the 5G, Cloud computing, Semantic web and Cognitive radio. Combination of all or some of the above technologies is also an interesting option. The IoT era means a whole new world of services and applications. These include the Smart City application where a set of smart sensors and IoT device monitors everyday city activities and helps in forecasting, reducing energy consumption, and among others avoiding traces congestion. Additional application for IoT systems

includes the transportation, logistics, and the healthcare. In this paper, we review all the above domains and discuss technology. The rest of the paper is organized as: Section 2 provides a brief overview of 5G and IOT. Section 3 highlights the cloud computing technology in IoT. Section 4 provides the information about semantic web and how this technology is used in IoT. Section 5 shows the cognitive radio technology and its contribution over IoT. Finally, the conclusions are being enlightened in Section 6.

II. 5G(FIFTH GENERATION) AND IOT

1. 5G:

Wireless communication technology in cell phones and hand-held devices has evolved over several decades. In mobile communication, Radio communication systems have experienced drastic changes about every ten years starting with the 1G (First Generation) since 1980's.1G was introduced in 1980 with the facility of voice calls using analog protocols. 2G (Second Generation) was introduced in 1991, which were launched on GSM (Global System for Mobile communication) standard in 1991. The upgrade of 2G over 1G is digital encryption of phone calls, higher efficiency on the spectrum and introduced SMS text messaging. 3G (Third Generation) was introduced in 2001 with faster internet speed. The upgrade of 3G over 2G is high-speed network.4G was introduced in 2010. It was a complete redesign of 3G and results in drastic reduction in transfer latency, increases efficiency and speed of network.5G is still in developing stage, researches are going on and it is to be launched in 2020. 5G includes faster speed with low power requirements to support IOT (Internet of Things).

It is capable to provide faster dialing speed, multiple device connectivity and higher data speed. In the modern world, IOT (Internet of Things) plays a vital role in the improvement of smart world.

2. 5G TECHNOLOGY IN IoT:

5G network speeds is calculated as high as 10-20 Gbps, which allows the rapid transmission of large amount of data between the connected IoT devices. Reliable for bandwidth-hungry applications, 5G provides an even broader array of IoT capabilities, for example artificial intelligence and advanced virtual reality. The another key benefit of 5G in accordance with increased speed is lower latency(time taken between the request of data and its termination) targeted to have less than one millisecond latency and increased reliability.5G enables mission-critical IoT applications which require maximum responses and reliability that is ranged from industrial automation through an driverless vehicles and remote health care. 5G also supports the devices with low power consumption and high energy efficiency requirements, such as smart cities. NB-IoT and LTE-M networks serve this purpose today. These multiple factors combined with 5G's high connection density will allow the IoT deployments to expand in scope and operate with greater efficiency. 5G pave for future technologies.

III. CLOUD COMPUTING AND IoT

1. CLOUD COMPUTING:

The process of proving information technology services in which information are fetched from internet through web-based tools applications, without direct connection to a servers is called as cloud computing. Cloud computing are nothing but, accessing data and programs from a centralized pool of computing resource that can be ordered and consumed on demand. Three types of cloud computing are private cloud, public cloud and hybrid cloud.

[1]Private Cloud Services is said to be secure cloud that can access from the specified organization. The additional security offered by a private cloud model is supreme for any organization, including enterprise, which needs to store and process private data. For example, a private cloud service is utilized by financial company that is required to store sensitive data internally.[2]Public Cloud Service is same as Private cloud , the main difference is that resources which are used to process and store data can be shared with another organizations, and data transferred over a public network example: internet.[3]Hybrid Cloud is one of the cloud computing environment that uses a mix of on premise, private cloud and third party public cloud services. With the hybrid cloud model, IT (information technology) decision makers have more control on both the private and public component.

2. THE ROLE OF CLOUD COMPUTING IN THE IOT REVOLUTION:

The IoT generate a large amount of Big Data and this in turn produces a enormous strain on the Internet Infrastructure. As a result, this forces companies to find solutions by minimizing the pressure and solve their problem in transferring large amounts of data. Cloud computing and IoT are connected and provides the rapid development of associated technologies which is used to create a widespread connection of "things". This leads to the production of large amounts of data that needs to be stored, processed and accessed. Cloud computing acts as the model for big data storage and analytics. The real innovations of IoT will be

produced when combining IoT and Cloud computing that enables new monitoring services and powerful processing of sensory data streams. For example, sensory data can be uploaded and stored with the help of cloud computing, later to be used intelligently for smart monitoring and actuation with other smart devices.

IV. SEAMANTIC WEB AND IOT

1. SEMANTIC WEB:

The Semantic Web is a network of data that is associated in such a way that it reduces human operators and they can easily be processed by machines. It is considered as an extension of the existing World Wide Web. The Semantic Web is a process that permits machines to understand and react to complex human requests faster subject to their meaning. The goal of the Semantic Web is to target the development of the existing Web to enable users to search, share, discover and join information with less effort. Humans have authority to use the Web for the execution of multiple tasks, such as booking online tickets, online banking, searching for different information, using online dictionaries, etc.Even though machines are capable to take certain task, they are unable to carry out any of these tasks without human interaction because Web pages are created to be read by humans, not machines. The Semantic Web is considered as the future from which the data could be quickly interpreted by machines.

2. SEMANTIC WEB MEETS INTERNET OF THINGS:

An increasing interest and worldwide adoption of Internet of Things (IoT) and Web based technologies are release a true potential of sketching a broad range of high-quality consumer applications. Smart cities, smart buildings, smart manufacturing and e-health are the various application domains which are used in recent years, benefiting and continuing to benefit from IoT and Web technologies in a foreseeable future. Like IoT, semantic technologies also proven its effectiveness in various domains and a few among multiple challenges which semantic Web technologies are addressing are to (i) Reduce heterogeneousness by supplying semantic inter-operability, (ii) facilitates integration of data application, (iii) conclude and extract new knowledge to build applications providing smart solutions, and (iv) facilitate inter-operability among various data processes.

V. COGNITIVE RADIO AND IOT

1. Cognitive radio (CR):

Cognitive radio is considered as one of the long term developments takes place in the recent years and radio receiver and radio communications technology. After the Software Defined Radio (SDR), Cognitive radio (CR) is slowly becoming more of a reality. Cognitive radio is the adaptive, intelligent radio that is programmed and dynamically configured to detect the best wireless channels. CR uses a large number of technologies. Adaptive radio and SDR where considered as the traditional hardware components including mixers, modulators and amplifies have been replaced with intelligent software by CR.The idea for cognitive radio is to utilize the radio spectrum more efficiently.

2. COGNITIVE RADIOPLATFORM FACING THE IoT:

Internet of things is the combined product of information sensing, transformation and processing. When this concept is arise, the governments, enterprises and academic institutes pay high attention towards Cognitive radio in IoT. It spreads all over the world under the push of demand and research. The IoT's rapid development needs the support of various wireless technologies. As a result, it faced new challenges in the management and utilization of the spectrum resources. The IoT will be used in all diversity of industry in the future. Thus, it will form far greater wireless access data than human communication interconnected mobile communication and bring mass terminal. In simple, shortage in spectrum resources will become the blockage of the IoT's development in the near future. Because the Cognitive Radio (CR) technology can automatically detects the radio environment, adjust the transmission parameters, it effectively improves the spectrum efficiency. Apply CR to the IoT will meet the increasing demand of frequency. The cognitive radio paved the way for better use of the IoT. The emerging of cognitive radio starts a new situation for solving the frequency resources shortage, realizing the dynamic management and improving the frequency spectrum efficiency. As the U.S. FCC open the TV white space, the products based on cognitive radio was considered as the burning needs. As a result, the researchers made specific research and developed some hardware platform. The platform supports the practical application of CR, especially the IOT.

VI. CONCLUSION

Hope this paper provides a brief explanation of IoT and the technologies that support future IoT. Internet of Things is the concept of virtual world of information technology connected to the real world of things. The technologies such as, 5G, Cloud computing, Semantic web and Cognitive radio paved the way for the future IoT. These technologies change our life better and more comfortable.

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