A Review on Things of Internet (IoT)

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ABSTRACT - *One of the buzzwords in the Information Technology is Internet of Things (IoT). The future is Internet of Things, which will transform the real world objects into intelligent virtual objects. The IoT aims to unify everything in our world under a common infrastructure, giving us not only control of things around us, but also keeping us informed of the state of the things. In Light of this, present study addresses IoT concepts through systematic review of scholarly research papers, corporate white papers, professional discussions with experts and online databases. Moreover, this research article focuses on definitions, geneses, basic requirements, characteristics and aliases of Internet of Things. The main objective of this paper is to provide an overview of Internet of Things, architectures, and vital technologies and their usages in our daily life. However, this manuscript will give good comprehension for the new researchers, who want to do research in this field of Internet of Things (Technological GOD) and facilitate knowledge accumulation in efficiently.*

Keywords: Internet of Things, IOT Vision, RFID, WSN, Applications of IOT

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1. INTRODUCTION

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" was Mark Weiser's central statement in his seminal paper in Scientific American in 1991. There is a sea change in human's daily life as well as in working conditions in organizations after the arrival of IT and ITeS technologies [1]. This is becoming well-known concept across many horizontal and vertical markets including a common man's everyday life in the society, as it has several applications. The development of the Internet of Things [IoT] has been primarily driven by needs of large corporations that stand to benefit greatly from the foresight and predictability afforded by the ability to follow all objects through the commodity chains in which they are embedded. The ability to code and track objects has allowed companies to become more efficient, speed up processes, reduce error, prevent theft, and incorporate complex and flexible organizational systems through IoT. The IoT is a technological revolution that represents the future of computing and communications, and its development depends on dynamic technical innovation in a number of important fields, from wireless sensors to nanotechnology. They are going tag each object for identifying, automating, monitoring and controlling [1].

2. VISION

In 2005, ITU reported about a ubiquitous networking era in which all the networks are interconnected and everything from tires to attires will be a part of this huge network. Imagine yourself doing an internet search for your watch you lost somewhere in your house. So this is the main vision of IoT, an environment where things are able to talk and their data can be processed to perform desired tasks through machine learning [2]. A practical implementation of IoT is demonstrated by a soon-to-be released Twine, a compact and low-power hardware working together with real-time web software to make this vision a reality. However different people and organizations have their own different visions for the IoT. An article published in Network World revealed IoT strategies of top IT vendors, they carried out some interviews from the key IT vendors. As of HP's vision, they see a world where people are always connected to their content. Cisco believes in the industrial automation and convergence of operational technology [2]. Intel is focused on empowering billions of existing devices with intelligence. Microsoft does not consider IoT as any futuristic technology; they believe that it already exists in today's powerful devices and that the devices just need to be connected for a large amount of information which could be helpful [3]. While, IBM has a vision of a Smarter Planet by remotely controlling the devices via secured servers. Despite of having different visions, they all agree about a network of interconnected devices therefore more developments within the coming decades are expected to be seen including that of a new converged information society.

3. INTERNET OF THINGS

The Internet of Things is a novel paradigm shift in IT arena. The phrase "Internet of Things" which is also shortly well-known as IoT is coined from the two words i.e. the first word is "Internet" and the second word is "Things" [4]. The Internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies [4]. Today more than 100 countries are linked into exchanges of data, news and opinions through Internet. According to Internet World Statistics, as of December

31, 2011 there was an estimated 2, 267, 233, 742 Internet users worldwide (Accessed data dated on 06/06/2013: from the Universal Resource Location http://www.webopedia.com/TERM/I/Internet.html).
This signifies 32.7% of the world's total population is using Internet.

Even Internet is going into space through Cisco's Internet Routing in Space (IRIS) program in the coming fourth years (Accessed on 10/05/2012: (http://www.cisco.com/web/strategy/government/space-routing.html). While coming to the Things that can be any object or person which can be distinguishable by the real world [6]. Everyday objects include not only electronic devices we encounter and use daily and technologically advanced products such as equipment and gadgets, but "things" that we do not do normally think of as electronic at all—such as food, clothing; and furniture; materials, parts and equipment, merchandise and specialized items; landmarks, monuments and works of art and all the miscellany of commerce, culture and sophistication. That means here things can be both living things like person, animals—cow, calf, dog, pigeons, rabbit etc., plants—mango tree, jasmine, banyan and so on and nonliving things like chair, fridge, tube light, curtain, plate etc. any home appliances or industry apparatus. So at this point, things are real objects in this physical or material world [6].

4. RADIO FREQUENCY IDENTIFICATION (RFID)

Radio Frequency Identification (RFID) is the key technology for making the objects uniquely identifiable. Its reduced size and cost makes it integrable into any object [7]. It is a transceiver microchip similar to an adhesive sticker which could be both active and passive, depending on the type of application. Active tags have a battery attached to them due to which they are always active and therefore continuously emit the data signals while Passive tags just get activated when they are triggered. Active tags are more costly than the Passive tags however they have a wide range of useful applications. Radio Frequency Identification (RFID) system is composed of readers and associated RFID tags which emit the identification, location or any other specifics about the object, on getting triggered by the generation of any appropriate signal. The emitted object related data signals are transmitted to the Readers using radio frequencies which are then passed onto the processors to analyze the data [7].

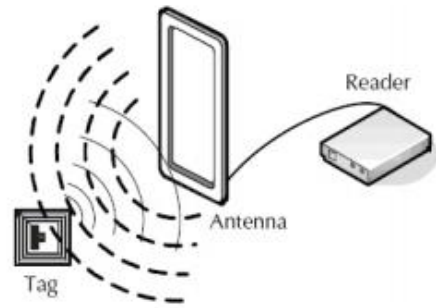

Fig. 1: Radio Frequency Identification (RFID) Scenario

Depending on the type of application, Radio Frequency Identification (RFID) frequencies are divided into four different frequencies ranges [8], which are given below:

(1) Low frequency (135 KHz or less)

(2) High Frequency (13.56MHz)

(3) Ultra-High Frequency (862MHz 928MHz)

(4) Microwave Frequency (2.4G, 5.80)

Bar Code is also an identification technology which has almost the same function as an Radio Frequency Identification (RFID) but RFID is more effective than a Bar Code due to a number of its benefits. Radio Frequency Identification (RFID) being a radio technology doesn't require the reader to be physically in its vision while Bar Code is an optical technology which cannot work unless its reader is placed in front of it. Moreover, an Radio Frequency Identification (RFID) can work as an actuator to trigger different events and it has even modification abilities which Bar codes clearly don't have.

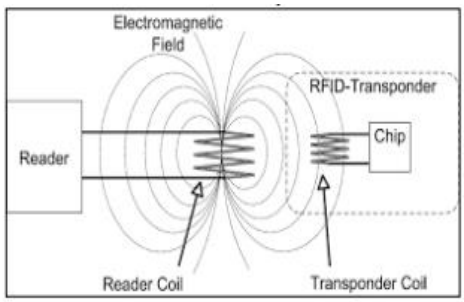

Fig. 2: Basic Functioning of Radio Frequency Identification (RFID)

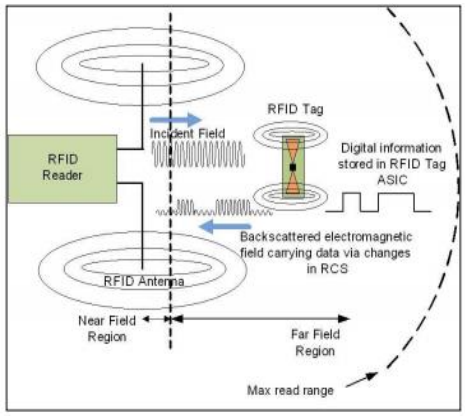

Fig. 3: Radio Frequency Identification (RFID) Communication

5. WIRELESS SENSOR NETWORKS (WSN)

The advancement and convergence of Micro Electro-Mechanical Systems (MEMS) technology, wireless communications and digital electronics has led to the development of miniature devices having the ability to sense, compute and communicate wirelessly over short distances. These miniature devices called nodes interconnect to form wireless sensor networks as shown in figure 4 and find wide ranging applications in environmental monitoring, infrastructure monitoring, and traffic monitoring etc. the components that make up the WSN monitoring network include:

A) Wireless Sensor Networks **(***WSN) hardware:* It contains sensor interfaces, processing units, transceiver units and power supply [5].

B) Wireless Sensor Networks **(***WSN) communication stack:* Nodes in WSN need to communicate among themselves in order to transmit data in single or multi-hop to a base station. The communication stack at the sink node must be able to interact to the outside world through the internet to act as a gateway to WSN subnet and internet [5].

C) Wireless Sensor Networks **(***WSN) Middleware:* It is a mechanism to combine cyber infrastructure with Service Oriented Architecture (SOA) and sensor networks to provide access to heterogeneous sensor resources in a deployment independent manner. It is based on isolating resources that can be used by several applications.

D) Secure Data Aggregation: In order to extend the lifetime of networks as well as reliable data collected from sensors, an efficient and secure data aggregation method is required. Ensuring security is critical as the system is linked to actuators and protecting systems from intruders is very important

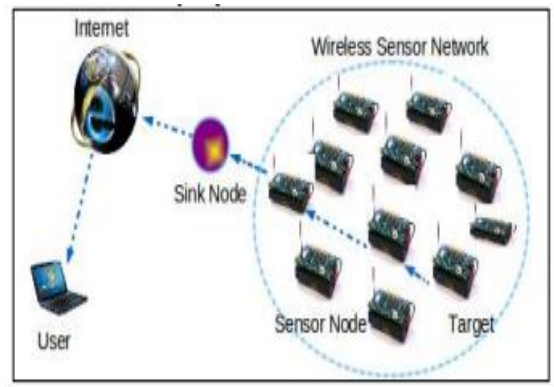

Fig. 4: Wireless Sensor Networks (WSN) Communication

6. APPLICATIONS OF IOT

Most of the daily life applications that we normally see are already smart but they are unable to communicate with each other and enabling them to communicate with each other and share useful information with each other will create a wide range of innovative applications. These emerging applications with some autonomous capabilities would certainly improve the quality of our lives. A few of such applications are already in the market, let's take the example of the

Google Car which is an initiative to provide a self-driving car experience with real-time traffic, road conditions, weather and other information exchanges, all due to the concept of IoT. There are a number of possible future applications that can be of great advantage. In this section, we present few of these applications [9].

A. Smart Home and Smart Metering: IoT has large application in home environments, where heterogeneous embedded devices enable the automation of common in-house activities. Several smart-home applications proposed in literature involve (wireless) sensor networks and implement smart metering solutions to provide recognition of appliances, intelligent management of energy consumption, lighting, heating, and air conditioning [9].

B. Smart Traffic System: Traffic is an important part of a society therefore all the related problems must be properly addressed. There is a need for a system that can improve the traffic situation based on the traffic information obtained from objects using IoT technologies. For such an intelligent traffic monitoring system, realization of a proper system for automatic identification of vehicles and other traffic factors is very important for which we need IoT technologies instead of using common image processing methods [9]. The intelligent traffic monitoring system will provide a good transportation experience by easing the congestion. It will provide features like theft-detection, reporting of traffic accidents, less environmental pollution. The roads of this smart city will give diversions with climatic changes or unexpected traffic jams due to which driving and walking routes will be optimized. The traf- fic lighting system will be weather adaptive to save energy. Availability of parking spaces throughout the city will be accessible by everyone [9].

C. Automotive and smart mobility: As an emerging technology, IoT is expected to offer promising solutions to transform transportation systems and automobile services (i.e., Intelligent Transportation Systems, ITS). A new generation of IoT-based vehicular data Clouds can be developed and deployed to bring many business benefits, such as increasing road safety, reducing road congestion, managing traffic, and recommending car maintenance or fixing as shown in figure 6. The huge number of vehicles and their dynamically changing number make system scalability difficult to achieve. Vehicles moving at various speeds frequently cause intermittent communication impacting performance, reliability and Quality of Service [10].

D. Healthcare: Smart devices, mobile internet and cloud services contribute to the continuous and systematic innovation of healthcare and enable cost effective, efficient, timely and high quality ubiquitous medical services. The services provided include chronic disease management, elderly care, wellness and fitness programs etc. [10].

E. Utilities (energy, water, gas): The application of IoT in this field include real time collection of usage data, local balancing, demand supply prediction, dynamic tariff generation etc. consumers connected to these smart networks have seen significant cost and resource savings [11].

F. Manufacturing: Remote monitoring and diagnostics, production line automation, equipment handling and diagnostics through sensors located on the production floor etc. are some of the solutions provided by IoT. The outcome ranges from reduced field support costs, lower breakdowns to improved operational efficiency [12].

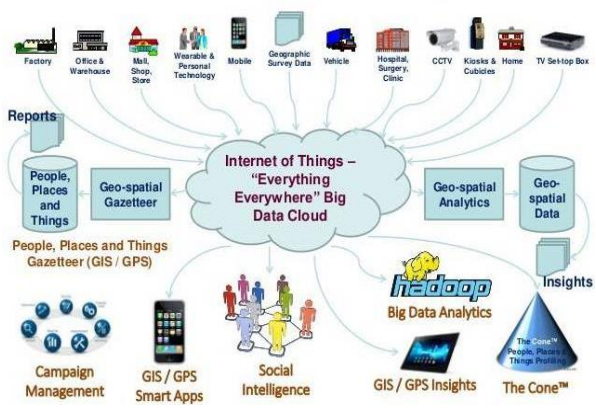

Fig. 5: Various Applications of IoT

7. CONCLUSION

With the incessant burgeoning of the emerging IoT technologies, the concept of Internet of Things will soon be inexorably developing on a very large scale [13]. This emerging paradigm of networking will influence every part of our lives ranging from the automated houses to smart health and environment monitoring by embedding intelligence into the objects around us. In this paper we discussed the vision of IoT and presented a well-defined architecture for its deployment [14]. Then we highlighted various enabling technologies and few of the related security threats. And finally we discussed a number of applications resulting from the IoT that are expected to facilitate us in our daily lives. Researches are already being carried out for its wide range adoption, however without addressing the challenges in its development and providing confidentiality of the privacy and security to the user, it's highly unlikely for r it to be an omni-present technology [15]. The deployment of IoT requires strenuous efforts to tackle and present solutions for its security and privacy threats.

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