Internet of Things: Applications and Challenges

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Abstract— Internet of Things (IoT) refers to the latest technology which is changing the way of looking towards the world. The terminology Internet of Things (IoT) refers to a future where every day physical objects are connected by the Internet in one form or the other, but technology is quickly changing the way we interact with the world around us. It is the advancements in the networking with the help of which real world objects can be connected to communicate with one another without human intervention. IoT envisions a future in which both digital and physical world can be linked, by means of appropriate information and technologies. IoT is supported by the wide range of distributed devices with embedded identification, sensing and/or actuation capabilities. In this paper will discuss the applications and challenges of Internet of Things (IoT).

Keywords— Internet of Things, IoT Components, IoT Applications, Challenges, Smart Home, Smart Environment, Smart Cities.

I. INTRODUCTION

The term Internet of Things (IoT) was first used by Kevin Ashton from the United Kingdom in 1999. It is a network of networks where typically a large number of objects or sensors are connected through communications and information infrastructure to provide value-added services [1]. Technologies changes our life. Out of many emerging technologies Internet of Things (IoT) is regarded as a technology and economic wave in the global information industry after the internet. The IoT is an intelligent network which connects all things to the internet for the purpose of exchanging information and communicating through the information sensing devices in accordance with agreed protocols [2]. The world has now entered into an extraordinary period in which company services or products and electrical devices (e.g., sensors) are connected devices. These devices communicate with each other without any interaction with a human [3]. The internet has an impact on education, communication, business, science, government and humanity. Clearly, the internet is one of the most important and powerful creations in all human history and now with the concept of the internet of things, internet becomes more favourable to have a smart life in every aspect.

By the Internet of Things, objects recognize themselves and obtain intelligence behaviour by making or enabling related decisions thinks to the fact that they can communicate information about themselves. Figure 1 reviews that with the Internet of Things, anything will be able to communicate to the internet at any time from any place to provide any services by any network to anyone [4].
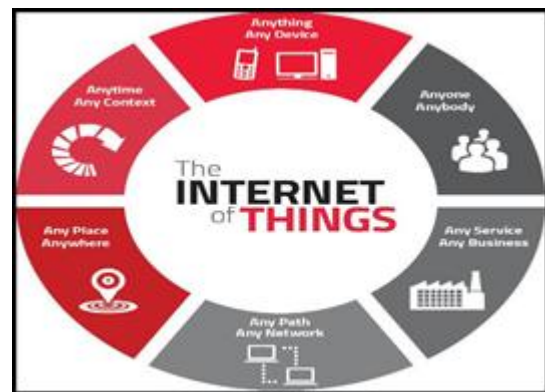

Figure 1. Internet of Things Concept.

Over last twenty years innovative information technologies have wrought significant change in human civilization. For example, imagine that you were to give a speech in another city which is normally one hour away from where you live. Unfortunately, there was traffic jam on the highway and you were expected to be late. If this happened 30 years ago, there was literally no way you can communicate the news to your audience. Nowadays, if you get stuck on the highway, you can simply use your cell phone to communicate. This is because cell phones and telecommunication service are

affordable and available to almost everyone. Question is: Can technologies do better? [5]

    More game-changing capabilities are emerging. First, new types of sensors enhance our perceptual abilities by detecting information that humans cannot detect and collecting such information anytime and anywhere. Second, wireless communication and broadband internet technologies enhance our communication capabilities, a power that will only grow when latest wireless and greater internet bandwidth become available. Third, emerging cloud computing and machine intelligence will enhance our analytical capabilities. With massive computation capabilities and more mature machine learning techniques, we may begin analysing information that could not be processed in the past.

    Till now, internet was meant to connect people with each other who could interact, share information, send messages, and even hold video conferences. But with the advent in technologies apart from man-to-man, man-to-machine interactions, we have machine-to-machine interactions as well. A key point is that while most of the machines and devices connected to the internet are computers such as laptops, servers, smart phones, and tablets, the IoT concept is much broader. More specifically, everyday objects that not previously seemed electronic at all are starting to be online with embedded sensors and microprocessors connected to the Internet. This includes items like food, clothing, fridges and household appliances, subassemblies, commodities, luxury items, landmarks, buildings and roads [6].

II. LITERATURE REVIEW

Prajakta Deshpande, Anuja Damkonde and Vaibhav Chavan [7]: This paper reviews the growing technology in Internet of Things, the potential and intelligence of IoT and the automation in IoT which changes the level of technology. They have also surveyed the development in IoT implementation and its applications. They have also briefed about the architecture and the different layers of the architecture.

Yogita Pundir, Nancy Sharma and Yaduvir Singh [1]: This paper surveys the existing development in IoT solutions, their functionalities and technology implemented for providing value to the people of this world. The goal is to highlight the concepts of IoT and the barriers occurring in IoT for the future development.

III. COMPONENTS OF INTERNET OF THINGS

For any IoT deployment, there are several key elements need to be placed at right position and here are some which can be seen in the next part. Figure 2 describes about various components of Internet of Things [8].
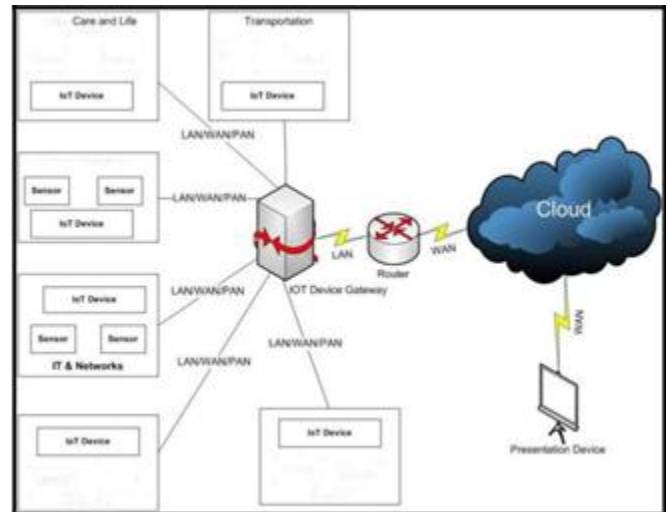

Figure 2. Various components in an IoT deployment.

A. Sensor
A sensor is a device that detects and responds to some type of input from the physical environment. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

B. IoT Device
The next level comes after collecting data from sensors is to use it. A device provides the intelligence to use this data by transforming or translating i.e. processing this raw information so that it can be converted to logical information [8].

C. Device Gateway
Device gateway is a device which aggregates data. It has significant computing and networking capabilities. In some IoT deployments, a Gateway is directly connected to the sensors.

D. Cloud
Internet of things creates massive data from devices, applications and users which has to be managed in an efficient way. IoT cloud offers tools to collect, process, manage and store huge amount of data in real time. Industries and services can easily access these data remotely and make critical decisions when necessary.
Basically, IoT cloud is a sophisticated high-performance network of servers optimized to perform high speed data processing of billions of devices, traffic management and deliver accurate analytics.

IV. APPLICATIONS OF INTERNET OF THINGS

It is incredible to visualise all the possible IoT applications, having in mind the progress of information technology and the distinct requirements of potential operators.
There are various field where IoT technologies have been used.

Some of these key field areas are as follows:

A. Smart City
A 'smart city' is an urban region that is highly advanced in terms of overall infrastructure, sustainable real estate, communications and market viability. It is a city where information technology is the principal infrastructure and the basis for providing essential services to residents [1]. Smart city may still be viewed as a city of the future and smart life, and by the innovation rate of creating smart cities today's, it will become very feasible to enter the IoT technology in cities development. By the IoT, cities can be improved in many levels, by improving infrastructure, enhancing public transportation, reducing traffic congestion, and keeping citizens safe, healthy and more engaged in the community [4].

B. Smart Homes
Smart Home is the integration of technology and services through home networking for a better quality of living. The growth of the Internet's and Wi-Fi's role in home computerisation has mainly come about because of the networked nature of different installed electronic devices, such as mobile devices, LCDs and TVs that are an ongoing part of the home Internet Protocol network, and due to the growing rate of mobile phone use of other computing devices, such as tablets and smartphones [9]. Some of the basic IoT applications underway in the connected home and building include temperature monitoring, security, building automation, management of peak and off-peak electricity usage and smart power meters. The smart home can be simply thought of as an integration of all household installations, via a control unit the computer or the Internet. Sensing devices, which are the core of IoT, are deployed to sense the things and environment around them, such as temperature, and conveyed through wireless network to the control units. The comfort level at home can be automatically adjusted with the use of sensors which sense the surrounding temperature and humidity [10].

C. Smart Health Care
IoT based health care monitoring solutions are getting considerably larger market in recent years due to the independent living styles. These solutions are much helpful for the people who need special attention and care such as chronic disease patients, women, person with disabilities and the elderly. IoT gives a perfect platform to realize this vision using body area sensors and IoT back end to upload the data to servers [11]. Many peoples around the worlds are suffering from the bad health because they don't have ready access to effective health monitoring and may be a suspected to be as critical situation patients. But with small, powerful wireless solutions connected through the IoT are now making possible for monitoring to come to these patients [12].

D. Smart Environment
Environment plays a major effect in Human life. People even animals, birds, and plants may be get affect by unhealthy environment. The Smart Environment in a city comprises of Smart Governance, Smart Mobility, Smart Utilities, Smart Buildings. The environment needs a smart ways and new technologies for monitoring and management. Monitoring the environment is important in order to assess the current condition of the environment to takes correct life decision according to collected data from monitoring systems, and management is needed to have an efficient resource consuming and use in addition to decrease the factories and vehicles wastes. Both monitoring and waste management provide a large amount of data to force the health standard by governments or healthy environment organizations to protect people and environment, and to mitigate or to avoid natural disaster that might occur [1].

E. Smart Transport
The development in transportation is one of the factors to indicate the wellbeing of the country. A road condition monitoring and alert application is one of the most important of IoT transformation application. The main idea of the smart transportation and mobility is to apply the principles of crowd sourcing and participatory sensing. The process began with user identified the route wishes and marked some points as pothole in the smart phone's application. IoT different technologies can work together in providing efficient transport services and enhance road safety. Monitoring of fuel level, tire pressure, acceleration level, brake condition etc. could help in vehicles to guard against sudden breakdown and accidents [11].

V. CHALLENGES OF INTERNET OF THINGS

The IoT provides many new opportunities to the industry and end user in many application fields. Like many other evolving IT and Networking technologies, Internet of Things also have many barriers or challenges.
Some of the challenges are presented in the below section.

A. Interoperability
IoT requires that different devices at different level need to have the capability to connect and exchange data among them. Since the Internet of Things, several heterogenous devices and different communication technologies are

required to be integrated to interoperability of data generated by Internet of Things resources which presents a big challenge for a generic IoT solution at a global level [13]. The different types of Interoperability's are mentioned below:

Technical Interoperability generally refers to
protocols and the infrastructure used in those
protocols for machine to machine communication.

1. Syntactical Interoperability refers to the data format used for communication.
2. Semantic Interoperability generally refers to the capability of computer system to exchange data which has not ambiguous shared meaning.
3. Organizational Interoperability refers to Automatic linkage of processes among different systems.

B. Security

Security is a crucial issue on the Internet, and it is probably the most significant challenge for the IoT. When you increase the number of connected devices, the number of opportunities to exploit vulnerabilities through poorly designed devices can expose user's data to theft, especially when the data streams are left with inadequate protection. In certain cases, it may even harm the safety and health of people.

There are a number of IoT deployments that also have collections of near identical or identical devices. This magnifies the impact of any one security vulnerability by the number of devices that all have similar characteristics.

To deal with all these unique challenges, there is a need for collaborative approach to security. A lot of users are ultimately going to have to compare the cost against the security, which is related the mass scale deployment of the Internet of Things devices.

C. Privacy

Another major challenge in acceptance of this ubiquitous connectivity through IoT globally is the privacy of trillions of objects and information hidden in them. The Internet of Things presents some unique challenges when it comes to privacy, and a lot of that goes far beyond the data privacy issues that exist currently. Much of this is because of the trouble integrating devices into the environments without people using them consciously. This is becoming even more prevalent when it comes to consumer devices, such as tracking devices for cars and phones and also smart TVs.

D. Architecture Challenge

IoT encompasses an extreme wide range of technologies. IoT involves an increasing number of smart interconnected devices and sensors (e.g., cameras, biometric, physical and chemical sensors) that are often nonintrusive, transparent and invisible. As the communications among these devices are expected to happen anytime, anywhere for any related services, generally, these communications are in a wireless,

automatic and ad hoc manner. In addition, the services become much more mobile, decentralized and complex. IoT architectures should be flexible to cater for cases such as identification, intelligent devices, and smart objects [2].

E. Standard

Standard plays an important role in forming IoT. A standard is essential to allow all actors to equally access and use. Development and coordination of standards and proposals will promote efficient development of IoT infrastructures and applications, services and devices [2]. A lack of documented or standard best practices has had a much larger impact on Internet of Things devices that goes well beyond simply limiting their development and potential. An absence of standards may well enable inappropriate behaviour by IoT devices. Without the right standards to guide and regulate manufacturers, developers may design products that operate in any number of disruptive ways online without regard for their impact.

The standard development process shall also be open to all participants and the resulting standards shall be publicly and freely available. When you add the difficulties of configuring and managing a large number of IoT devices, the need for standardization of methods, interfaces, configuration tools, and thoughtful design, along with IPv6 adoption, is essential for the future. In today's network world, global standards are typically more relevant than any local agreements.
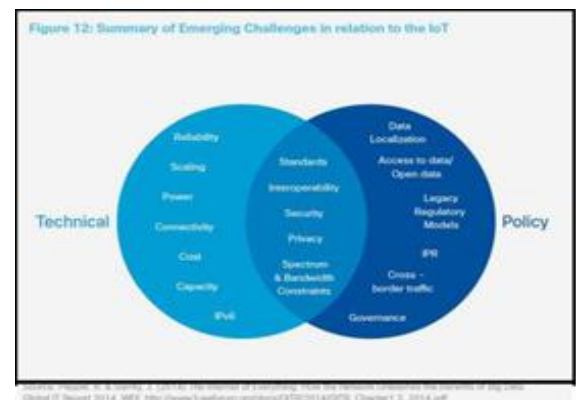

Figure 3. Challenges in relation to the IoT.

VI. CONCLUSION

Internet of Things (IoT) is a new technology which provides many applications to connect the human to things and things to things or machine to machine. The growing idea of the Internet of Things is pointing towards improving the quality of life by connecting many smart devices, applications and technologies. The internet of Things is growing around vertical stages, precisely suited to given situations and espousing exclusive communications, resource control and

device protocols. The potential and intelligence of IoT can save people and organizations time and money.

The Internet of Things is going to expand at a very rapid rate and with it there are going to be huge advancements in every field. As when we think of being connected to the Internet, our minds immediately shift to our computers, laptops, mobile phones, etc. The number of devices being connected to the Internet started to exceed the number of people on Earth to use them. The development of IoT will depend on technological advance and in getting the information from heterogenous sources, in reducing costs, and in improving efficiencies. Internet of Things also exposed many new challenges including the lack of fundamental theory support, unclear architecture and immature standards. The internet of Things promises future new technologies when related to cloud, distributed computing and security issues. By integrating all these issues with the Internet of Things, smarter applications will be developed as soon.

Thus, the development of IoT as an intelligent system have become an inevitable trend of development of information industry, which bound to bring new changes to our lives.

This paper explains some of the most important applications of IoT and the challenges that facing the limitations in the implementation of the Internet of Things (IoT).

REFERENCES

[1] Yogita Pundir, Nancy Sharma and Yaduvir Singh, "Internet of Things(IoT): Challenges and Future Directions." International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 3, March 2016.

[2] Shanzhi Chen, "A Vision of IoT: Applications, Challenges, and Opportunities with China Perspective." IEEE INTERNET OF THINGS JOURNAL., VOL., 1, NO. 4, AUGUST 2014.

[3] Saad Albishi, "Challenges and Solutions for Applications and Technologies in the Internet of Things." Procedia Computer Science 124 (2017) 608-614.

[4] Zeinab Kamal Aldein and Elmustafa Sayed Ali Ahmed,"Internet of Things Applications, Challenges and Related Future Technologies." WSN 67(2) (2017) 126-148.

[5] Yen-Kuang Chen, "Challenges and Opportunities of Internet of Things." 978-1-4673-0772/7/12.

[6] Zaid Ajas Moharkan, Tanupriya Choudhary, Subhash Chand Gupta and Gaurav Raj," Internet of Things and its Application in E-Learning." 3rd International Conference on "Computational Intelligence and Communication Technology" (IEEE-CICT 2017).

[7] Prajakta Deshpande, Anuja Damkonde and Vaibhav Chavan," The Internet of Things: Vision, Architecture and Applications." International Journal of Computer Applications (1975 – 8887 Vol –No.2, Nov 2017.

[8] Mayank Dixit, Jitendra Kumar and Rajesh Kumar, "Internet of Things and Challenges." 978-1-4673-7910-6/15 2015 IEEE.

[9] S.B. Yoon, B. Petrov, and K. Liu, "December. Advanced wafer level technology: Enabling innovations in mobile, IoT and wearable electronics," In Electronics Packaging and Technology Conference (EPTC, IEEE), pp. 1-5, 2015.

[10] Swan, M. (2012). Sensor mania! The Internet of Things, wearable computing, objective metrics, and the Quantified Self 2.0. Journal of Sensor and Actuator Networks, 1(3), 217-25.

[11] Khaled Abdulla Al Rabaiei and Saad Haorus," Internet of Things: Applications and Challenges" 2016 12th International Conference on Innovations in Information Technology (IIT).

[12] Mobyen Uddin Ahmed, Mats Bjorkman, Aida Čaušsević, Hossein Fotouhi, and Maria Linden. An Overview on the Internet of Things for Healthy Monitoring Systems.

[13] Ovidiu Vennesa, Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers, 2013, pp. 278-279.

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