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Chapter

Introductory Chapter: Internet of Things (IoT) Importance and Its Applications

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1. What is the Internet of Things?

Internet of Things is a recent technology that creates a global network of machines and devices that are capable of communicating and exchanging data with each other through the Internet. There is a difference between the Internet of Things and the Internet. Internet of Things can create information about the connected objects, analyze it, and make decisions; in other words, one can tell that the Internet of Things is smarter than the Internet. Security cameras, sensors, vehicles, buildings, and software are examples of things that can exchange data among each other.

2. Internet of Things challenges

As the number of real-time applications (devices) that need smart connections among each other is increased, the Internet of Things challenges will also increase. Such challenges are as follows.

2.1 Smart connectivity

Sensors and devices that are connected and communicated together through the Internet of Things infrastructure may need to update their trends or feature to be suited to the changes of surrounding environments. The Internet of Things is a smart infrastructure that can process the collected data and make the required decisions to improve itself and to change the trends or features of the connected devices to accommodate the surrounding environments' changes. Internet of Things is a smart technology that helps all connected devices to update themselves according to changes in the surrounding environment and to be able to be adopted and work in any other strange environment with high accuracy. As a result, smart connected system can be produced if smart infrastructure is well designed to treat the collected data from devices correctly, to make the needed decisions.

2.2 Keeping high privacy and security of all connected devices

The main idea of using the Internet of Things is to have a smart system and to connect billions of devices over the whole world. The expected devices to be connected together are expected to be 50 billion through the Internet of Things devices by 2020. **Figure 1** shows the growth of the world population and the connected devices by 2020. Connecting such a huge number of devices required high-security

levels to prevent scams and to allow high level of data protection. As a result, achieving high level of security is a big challenge to get the needed trust from both industries and individuals to share their data utilizing the Internet of Things.

2.3 Treating big data

The most important challenge of using the Internet of Things is the tremendous growth of the data transmitted between the connected devices. As seen in **Figure 2**, The basic three sources of data are (1) the database used in the business process; (2) the human daily activities such as email, Facebook, and weblogs; and (3) the connection of physical devices such as cameras and microphones. It is worth mentioning that a full 90% of all the data in the world has been generated over the last 2 years. This makes it more challenging for the Internet of Things infrastructure designers to deal with such growth of the generated data.

2.4 Reducing the overall data latency among machine-to-machine interactions

While connecting many devices through the Internet of Things infrastructure, the shared data among them will also tremendously increase. This will cause some delay or latency of data delivery among the connected devices. This opens a new challenge to be addressed by the Internet of Things to reduce such latency to be sure a robust Internet of Things infrastructure will be obtained.

2.5 Reducing bandwidth and power consumption

Both bandwidth and power consumption of the numerous number of devices that are connecting, communicating, and sharing data among each other through the Internet of Things are tremendously increased. This is why when designing an Internet of Things infrastructure, both bandwidth and power consumption challenges should be considered. The main trend nowadays is to reduce the size of the connected devices,

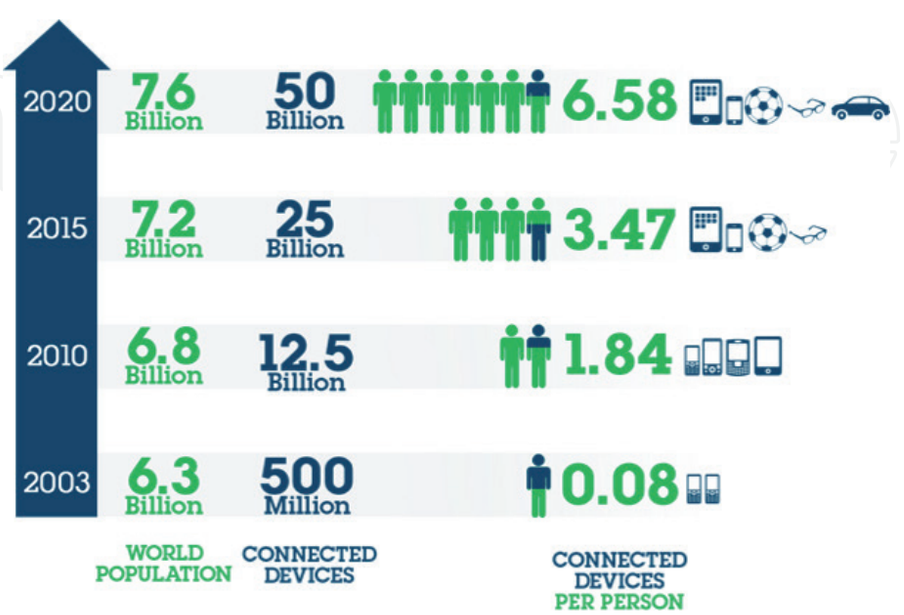

Figure 1.
The overall world population and the connected devices by 2020.

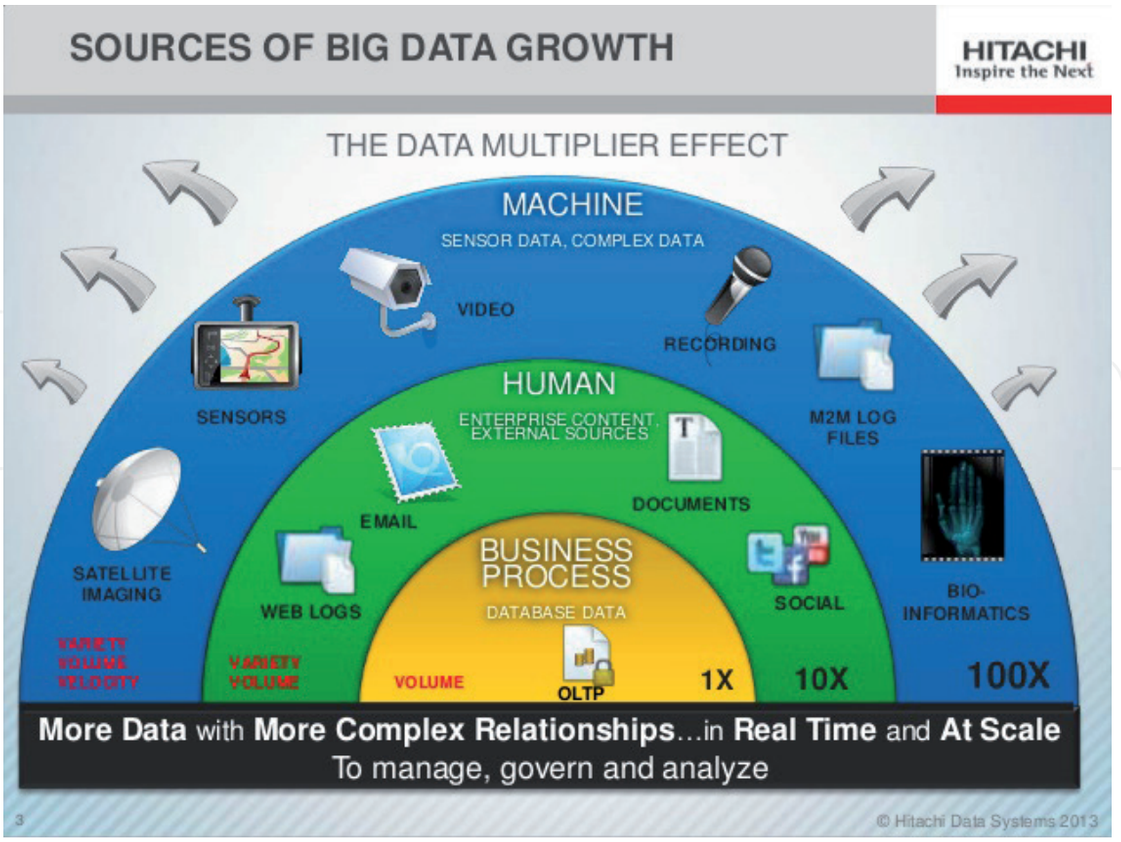

Figure 2.
Different sources of data growth (https://www.slideshare.net/bjorna/big-data-in-oil-and-gas).

and as a result, the power consumption will decrease. The transmitted data rate is still an issue to be solved due to the huge shared data among devices.

2.6 Complexity

Sharing data and connecting devices together through the Internet of Things can be implemented through several levels and layers of software/hardware and some standard protocols. With the tremendous increase in the shared data and connected devices, the used software/hardware and standard protocols will be more complicated. As a result, there is a challenge to reduce the complexity of the Internet of Things technology as the number of connected devices increases.

3. Internet of Things applications

The Internet of Things is recognized as one of the most important areas of future technologies and is gaining vast recognition in a wide range of applications and fields related to smart cities, military, education, hospitals, homeland security systems, transportation and autonomous connected cars, agriculture, intelligent shopping systems, and other modern technologies. The smart home is one of the main applications that use the Internet of Things infrastructure to connect several sensors. The sensors can sense and collect surrounding information that is used to fully control different home systems such as lighting and security as seen in **Figure 3**.

There are many other applications that use the Internet of Things infrastructures such as smart bridges and smart tunnels. Temperature and vibration sensors, as well as video surveillance cameras, can be fixed on a bridge to detect any abnormal

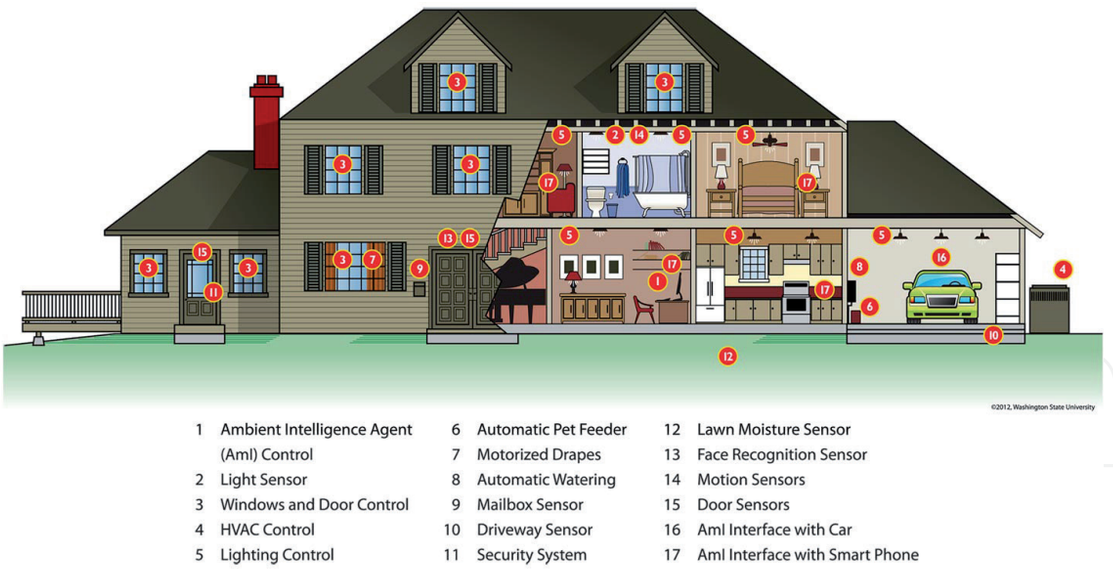

Figure 3.
SMART home sensors communication through the internet of things. (http://www.nibib.nih.gov/sites/default/files/SMART-HOUSE_2_DCook.jpg).

activity and send warnings via SMS. Also video processing analysis can be performed to control the traffic density on a bridge. The smart tunnel can use several sensors to monitor humidity, displacement, and temperature to call for appropriate maintenance if a problem is detected. All of these applications are using sensors to detect and collect data that are used to give a proper decision that maintains a high level of security of the installations.

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