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What is IoT? The Internet of Things explained

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The Internet of Things, also known as IoT, is a breakthrough, leading the tech industry to the new industrial revolution, i.e. "Industry 4.0". To understand its impact, it is important to know what preceded IoT, how it is defined, as well as its envisioned use. This article provides a brief overview of the industrial revolutions and their outcome. It focuses on defining IoT technology and Machine-to-Machine communication (M2M). It also provides examples of its everyday use and refers to major challenges of IoT, associated with the number of connected devices and the availability of data. Finally, the article draws conclusion on how IoT can be incorporated in everyday activities.

Introduction

There are currently millions of devices connected to the global network. This is due to the technological innovations of the last decades which led to users being constantly connected to devices in order to perform daily activities. Under this scope, the "Internet of Things" (IoT) is considered the technological breakthrough of this era. Scholars refer to IoT as part of the new industrial revolution or "Industry 4.0", along with other technologies, such as Big Data and cloud computing [1]. In particular, IoT reflects the need to process and fuse data generated from interconnected devices, as well as store them in a single massive network.

This article focuses on IoT and showcases its contribution to the tech industry. To understand its impact, three key questions are examined. Firstly, what preceded IoT, then its definition, along with M2M (Machine-to-Machine communication) and their envisioned use.

Lastly, the article discusses future challenges regarding the incorporation of IoT in our every-day lives and draws conclusions on its use.

An overview from the first Industrial Revolution to IoT

The tech industry has progressed vastly over the centuries. Its major transitions are defined by the four industrial revolutions: coal; gas; electronic devices and the Internet along with renewable energy. Each industrial evolution provided tools to achieve task automation.

More specifically, the first industrial revolution started in 1760. It led to the transition from hand to machine-automated processes, as well as to the increase of steam and water power. In Europe, this change first began in Great Britain and later spread across the continent. These advances gave birth to new tools, such as assembly lines, telegraph and power grids, as well as to mechatronics factory technological innovations.

As for the second industrial revolution, it started in the late 19th century. Specifically, it introduced the massive use and production of electrical power and communication networks, i.e. telephone services. This revolution started from the United States of America, introducing a industrialized method of production.

Subsequently, the third industrial revolution started in 1970 and it is currently progressing towards its end. This era is characterized by the automatization of production, placing emphasis on informatics and computer systems in general, as means to enhance and accelerate production. The next major development is the so-called "Industry 4.0" which is expected to bring extensive and fundamental changes to the tech industry.

What is IoT and M2M?

IoT is one of the enabling technologies of the "Industry 4.0". Its goal is the connection of humans with machines and smart technologies. The Internet of Things (IoT) refers to the vast interconnected network of computer devices (e.g., sensors) which exchange large amounts of data at rapid speed.

Moreover, the interconnectivity between these devices is achieved via Machine-to-Machine communication (M2M), i.e., a standardized way for various machines performing different operations to communicate and rapidly exchange information on a global scale. M2M is not just responsible for passing information; it also acts as the middleman providing an end-to-end layer for machines (or physical objects) to communicate in a global network, without human interaction. While these terms are frequently used interchangeably, it is important to state that connectivity itself is not IoT [2].

How can IoT facilitate everyday activities and the tech industry?

IoT can help users work and live "smarter", by facilitating everyday tasks and supporting our wellbeing. A prime example of IoT's many uses is home automation; this allows residents to have full control over domestic appliances via remotely controlled and internet-connected systems. M2M is responsible for constructing a communication channel between devices, whereas IoT processes this information and offers efficient suggestions to users. Information processing is typically implemented using Big Data analysis and other technology tools to achieve process automation and proactive assistance of residents in everyday tasks [3].

Additionally, IoT can be used as a tool for businesses to achieve "digital transformation". This term describes the need to reduce touchpoints throughout a business operation flow which reduces both the time and the cost of delivery. This is typically achieved by shifting business processes to cloud services and replacing monolithic applications with smarter systems.

As for the use of IoT by the tech industry, the so-called smart mobile IoT (M-IoT) is currently being developed in the field of mobile computing. This technology allows for the construction of new network protocol infrastructure which constitutes a secure environment for smart devices, including micro-computers and integrated circuits [4]. These IoT systems are important because they promote decentralized solutions which take advantage of "edge computing", meaning systems consisted of multiple remote nodes acting as IoT gateways. Lastly, potential uses of IoT can also include smart traffic management [5], healthcare and medicine [6], construction and civil infrastructure [7], open space security [8], smart cities [9], self-driving vehicles [10], energy consumption monitoring [11], wireless remote sensing [12], smart agriculture [13] and general industrial applications [14].

Which are the current challenges for IoT?

IoT currently faces two limitations; the number of connected devices and the availability of data. On the one hand, as evident from the data in Figure 1 [15], internet connection by users is steadily multiplying. However, there is still a long way before reaching global Internet coverage [16], since more than half the world's population lack access to the Internet [17].

On the other hand, IoT heavily relies on data by nature [19]. Indeed, more than 2.5 quintillion bytes (1 QB = 10^{18} bytes) of data are generated daily [20]. A large portion of this data is generated from interconnected electronic devices (e.g. laptops, cellphones, smart TVs, smart vehicle sensing, etc.) equipped with an abundance of sensory components. By the end of 2021, this number is expected to increase exponentially to 50 zeta bytes (1 ZB = 10^{21} bytes) as evident in Figure 2.
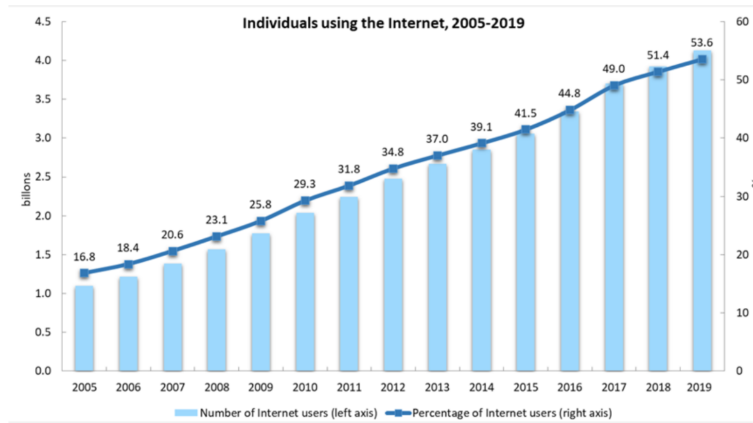
Figure 1. International Telecommunication Union's estimate for 2005-2019 Internet usage [18]
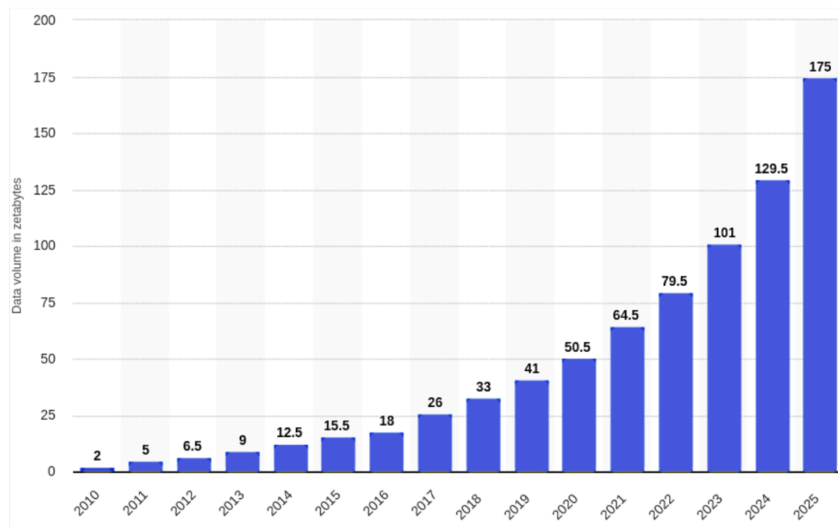

Figure 2. Volume of data created worldwide from and future predictions [21]

Conclusion

Due to the large volume of data exchanged daily through interrelated computing devices, the IoT sector is in high demand for scalable methods to handle, process, analyze and mine data at real-time. Recent studies suggest that many fields of computer science can benefit from IoT, including cloud computing, cybersecurity, Artificial Intelligence, Big Data, and data analytics.

It is noted that, while IoT is not be a "cure-all" solution, it introduces decentralized decision making, supporting information transparency and interconnectivity between informatics [22]. The question is not whether IoT can facilitate our lives, but whether the tech industry will seize this opportunity.

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