THE INTERNET OF THINGS: SOLUTIONS AND BENEFITS

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Annotation. The thesis deals with the term of the Internet of Things, the ways it can minimize human involvement in various activities, its contribution to technological development, as well as with the main IoT solutions, application areas and examples.

Keywords. Internet of Things, IoT market, IoT solutions.

In rapidly shifting ages of information technologies it seems totally inconceivable to distinguish a particular innovation that could change the world radically. However, it is acknowledged by the vast majority of experts that there is an extremely prosperous technology, which is highly probable to be the driver of a new technological revolution. The name of this technology is the Internet of Things (IoT).

According to the 2020 report, the global IoT market size stood at USD 761.4 billion and is projected to reach USD 1.4 trillion by 2027 [1]. On the grounds of given forecast, a survey among a group of students was conducted to determine the impact of IoT on responders' everyday life. Oddly, while all kinds of smart devices and systems, ranging from fitness bands to car sharing, are being used daily by 78,8% of surveyed students, only 42,4% of the group are familiar with the term "the Internet of Things" [2]. Hence, it is necessary to give a clear definition of IoT.

The Internet of Things is a technology that creates the network of smart physical objects, allowing them to gather, analyze, process and share the data with other devices — all performed with little to no human intervention. The term was coined in 1999 by Kevin Ashton of the Massachusetts Institute of Technology (MIT). Even though the concept grabbed a bit of public interest at the time, the technology itself got widespread attention somewhere between 2008 and 2009. The main reason for that was the explosive growth of the things-to-people ratio to the point, when the number of connected devices outreached the world population (figure 1).
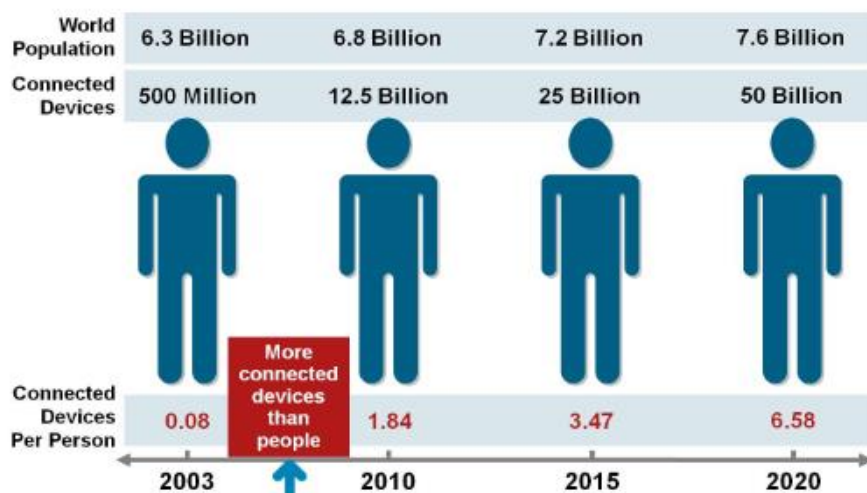

Figure 1 — things-to-people ratio 2003-2020 [3]

Virtually any physical object can be transformed into a smart device. This can be accomplished by means of such components as hardware, data, software, connectivity, and user interface. In a nutshell, a smart device operating iteration goes as follows: the data is collected by sensors that are connected to the Internet, sent to the cloud or the processing center, where it is handled by the software, and, eventually, the optimized information can be either displayed to the end-user through the user interface or transmitted onwards to the following devices. For instance, a smart refrigerator initially detects the items inside by a barcode with its embedded camera module, sends the data to the processing software and provides the user with a full item list on its LCD or forwards it to user's smartphone.

The constant increase of computing power and competitive prices on intelligent sensors allow a wide range of innovative IoT solutions to be introduced. The technology has already been well-established in numerous areas of human life. Based on the scope of use, IoT solutions can be divided into three primary domains: Consumer IoT (B2C), Enterprise and Industrial IoT (B2B), Public spaces IoT (B2G).

Consumer IoT comprises applications that are designed for use by the general public. The smart home system, which totaled around 221 million in the number of installed worldwide in 2020 [4], proceeds

to be one of the most thriving branches of the indicated domain. The setup enables owners to monitor living space condition and control smart appliances and devices remotely using a smartphone or other networked gadget. Moreover, it allows ensuring home security by remote surveillance of security cameras, access control and central door and window locking. Basic smart home kits include smart home management system (SHMS) — a platform to monitor and manage smart devices — as well as smoke detector, motion sensor, door and window locking sensors. Furthermore, additional equipment, for example, leakage sensor, smart socket, alarm siren, can be installed to build a full-fledged smart home system.

Smart homes do not lack recognition in Belarus either. The service in the country was pioneered by telecommunications company "Beltelecom". Despite the fact that the solution in Belarus is still in process of winning over the consumers, its growing popularity worldwide makes the technology more accessible and appealing to the domestic public, while also creating steadily increasing competition on the internal market.

Besides smart home, other solutions, namely, Internet-connected appliances, wearables, connected health-monitoring devices and beyond, also belong to Consumer IoT domain.

Notwithstanding the expansion of Consumer IoT domain, it can be problematic to earn revenue from applications of that type. Considerably higher demand is generated for Enterprise and Industrial IoT solutions, which are primarily used in areas of manufacturing, transportation, energy, etc.

A sizeable proportion of Enterprise and Industrial IoT solutions are implemented in the area of manufacturing. The digital transformation of production process is led by large industrial and technological companies such as Siemens and Microsoft. IoT-based factories play a major role in the current stage of technology-driven manufacturing. Smart factory is a highly digitalized shop-floor where the data is constantly collected and shared by means of Internet-enabled machinery, devices and production systems, embedded with a multiplicity of sensors. In the framework of a such system all components stay interconnected during the entire value chain, which goes beyond a particular enterprise or business. The increasingly widespread use of smart factories is explained by the potential benefits. While extending the capabilities of both machinery and personnel, smart factories create an efficient and agile production through data collection and improve decision-making by providing relevant and reliable information. As a result, smart factories can lower costs, reduce downtime and minimize waste.

Enterprise and Industrial IoT domain has good prospects in Belarus. In fact, the solution is being used by the large industrial company "Belaz". The products of the company are equipped with a wear gauge. Firstly, it allows the enterprise to perform a forehanded maintenance and schedule the purchase of spare parts. Secondly, the collected data enables the necessary adjustments to be made, thereby improving the quality of the product [5].

Public spaces IoT domain touches upon the problems of contemporary cities. The smart city concept has proven to be successful in solving such relevant urban issues as road congestions, air pollution, increasing population density and so forth. Similar to other IoT systems, smart cities link infrastructure and technology by creating a network of smart city objects. The system is being capitalized on in such progressive cities as Barcelona, London and San Francisco. Smart trash collection, intelligent parking, smart lighting and air quality monitoring are only a small fraction out of all possible solutions that increase resource efficiency, improve life quality, reduce pollution and result in significant cost savings.

Several smart city solutions are implemented in the streets of Minsk. For instance, there are around one thousand remote-controlled smart lamps functioning in several streets of the city. Automated lighting and smart malfunction detection cut energy and service costs respectively [6]. Another example would be the IBA Automated Fare Collection (IBA AFC) that has already been used in the city public transport system for six years. The solution simplified the public transport payment system by offering plastic travel cards alongside traditional tickets, which additionally reduced ticket printing costs [7].

Upon considering all the facts, the overall rise of the Internet of Things opens up a window of opportunities to shape a more sustainable and prosperous future for the whole world. However, global-scale problems of IoT such as hacking vulnerability and lack of standardization stifle the use of IoT. Therefore, it will take time for the Internet of Things to reach an advanced level of improvement, which would allow its limitless potential to be fully implemented without major concerns.

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