The Impact of IoT Technologies on Our Activities

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Abstract

The evolution of the IoT technologies is spectacular in recent years, from simple devices able to receive messages and to count the number of steps, to complex devices which get information about the heartbeat rate monitoring, body position, calories burned and even warn us about the UV radiation. The large amount of data from IoT devices is important also for the business environment. We interviewed ten people from Bucharest, who already used at least one IoT device, to understand the impact of the use of IoT technologies on our lives. We identified common characteristics of the people who use IoT applications and devices, and a user profile was created. This could help to understand the advantages and disadvantages of the IoT technologies usage and how it influences people in their lives.

1. Introduction

According to Ericsson company, one of the leading providers of IoT technologies, by 2024, there will be 4.1 billion mobile connections in the world (www.ericsson.com, 2020). Due to this technology, people will be able to communicate easily and efficiently, each user having the benefits of being a member of a social network with IoT applications. There are many independent research centers and companies investigating the opportunities and possibilities of integrating IoT solutions into social networks (SIoT). The Social Internet of Things has the potential to support and develop more efficient new IoT applications and network services (Atzori, Iera, Morabito, Nitti, 2012).

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There are many applications of IoT technologies, such as:

- Smart watches and bracelets are connected to the internet and to other devices, being focused on sport, health and smart home monitoring. There are several companies developing different models and designs, trying to make them easy to use, with long battery life.

- Traffic applications connect drivers and offer information about traffic, accidents, street damages and other useful information. This social network helps drivers to avoid traffic jams and get the shorter way to their destination.

- The e-wallet is an application that allows users to make payments in physical stores. The user's bank account is connected with this electronic wallet, the software stores shopping details which help the user to generate statistics with categories of expenditures and shopping behavior trends.

- Specialized stores, such as Amazon Go, where, with the help of sensors you can take products from the shelves, without queuing or paying at the cash register. Products are paid automatically from the Amazon card account.

- Devices and sensors for garments, for example some fashion brands introduced sensors in the sole of the sports shoes to get information about the number of steps or cadence. There are many IoT applications with social networks integrations, where people have the same interests and activities. Well-known fashion brands develop new tech models for t-shirts that monitor activities like breathing, heartbeat, body position - to have the best performance. Sensors connect enthusiasts of certain sports, such as skateboarding or parkour, and inform the social network users about the sport location and level of location's difficulty (beginners, advanced).

- Smart agriculture is based on sensors which offer information about temperature, humidity, wind, rain, pollution, much more accurate than the general forecast for a specific area.

- Smart homes generate a high degree of comfort, security and optimize energy consumption. Different from the traditional IoT architecture where devices have only wired connections, the IoT technologies allow smart devices (e.g., lighting control, access control, home healthcare, smart kitchen, and home appliances) to connect with each other via wireless communications (Meng, Zhang, Zhu, Shen, 2018).

- Smart promotion methods allow companies to use IoT technologies to communicate with the customer in an original and efficient way. Getting data about customer's behavior, location and preferences, companies could create strong and long-lasting ties between brands and clients. This represents a sustainable competitive advantage and improves the customer's experience with those brands. By adding internet connection to a physical product, it differentiates from other products and creates a strong connection between the customer and the brand. IoT applications have big potential in marketing strategies. This requires understanding a big amount of data, helping marketers to deliver products and services that meet the customers' requirements. (Simoes, Barbosa, Filipe, 2019)

- Smart education - based on IoT data, the courses could be personalized, which increase the students' efficiency. There are people with different learning difficulties, such as dyslexia, which affect about 10% of the population. They can benefit from the personalized courses, so they can understand and learn better. Also creating connections between students and professors may increase their involvement, leading to better results. To have smart learners we have to combine smart education and smart learning (Zhu Z-T., Yu M-H & Riezebos P., 2016)

- The use of IoT in cars' industry has grown a lot in recent years. At the same, the autonomous and semi-autonomous machine industry is developing many IoT applications. There are certain benefits of using IoT technologies in this industry: greater mobility of your people, more possibilities for people with disabilities, traffic issues, consumption deduction, increase the efficiency of the parking areas (Krasniqi X., Hajrizi E., 2016).
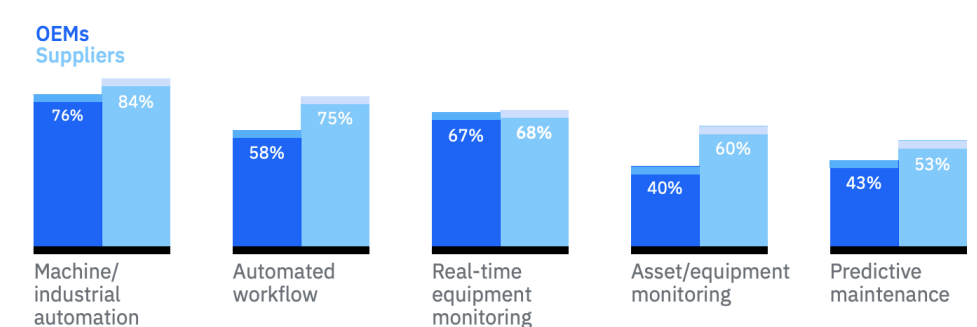

Figure 1. IoT technologies adopted in automotive plants and assembly lines (IBM, 2018)

IoT technologies have a major impact on us, transforming the way companies and consumers take action on a daily basis. We interviewed ten people from Bucharest, who already use IoT technologies and get important insights. The IoT technologies are transformative, having an impact on competition and how companies will create new business opportunities (Tsiatsis, Karnouskos, Holler, Boyle & Mulligan, 2018).

2. Qualitative research - methodology

The aim of this study is to determine the impact of IoT on our activities.
There were more steps in achieving our objectives:
a) *Identifying the issue and defining the purpose of the research*
b) *Objectives of the research*
c) *Method*
d) *Recruiting participants*
e) *Conversation guide*

In order to understand which is the impact of IoT technologies on our activities, we interviewed ten persons who used at least one IoT device.

a) Identifying the issue and defining the purpose of the research

The evolution of IoT technologies is spectacular in recent years. Due to the attraction of this domain, there are many IoT applications to help people organize better their activities, extending the connections between people. Companies are able to acquire new clients and build brand loyalty, having a direct communication with its existing and potential clients.

b) Objectives of the research

- To determine which are the most popular IoT applications;
- To identify the common characteristics of people using IoT technologies;
- To identify which are the advantages and disadvantages of using IoT technologies;
- To determine what is the motivation of using IoT technologies;
- To determine if IoT devices are easy to use.

c) Method

For this qualitative research we used the semi-structured interview technique, and the conversation guide tool. Using semi-structured interviews, we could get important information about people's opinion about the IoT technologies. Each interview was thirty minutes long, blending closed-ended and open-ended questions.

d) Recruiting participants

10 participants were selected. They should be active in at least one social media network.

The profile of the participants in this study:
- they have at least one IoT device;
- they used it regularly;
- students or employees;
- aged between 18 and 45 years old.

e) Conversation guide

The conversation guide addressed two topics, according to the research main objectives:

- General aspects about the use of IoT technologies

We have to determine which are the most popular IoT applications and which are the ones used by our interviewees. Based on their answers we'll identify the most common characteristics of IoT users and how often they use IoT applications. Do they have difficulties using IoT applications, what kind of difficulties?

- The impact of IoT technologies

We have to determine which are the advantages and disadvantages of using the IoT applications. What motivates people to use IoT applications and how

complex are these technologies? Users access online social networks for several purposes, which provide information about their interest, preferences, emotions and motivations. How do IoT applications influence users' activities?

3. General aspects about the use of IoT technologies

A total number of 10 people participated in the case study. They have at least one IoT device and they use it regularly. Following the information analysis, we formulated certain conclusions necessary to understand users' experience with IoT technologies and the impact of IoT devices on their activities.

Sensors are a key component for collecting data in real-time. They could identify more IoT applications such as:
- Smart homes;
- Smart cities;
- Smart watches;
- Smart cars;
- Smart textile;
- Smart agriculture.

Most of the participants in this study knew several technologies designed to turn their home into a smart home, such as smart plugs and bulbs, smart heating devices. Three of them bought and used smart plugs at home. A smart home is well-known for its energy consumption reduction. If a light bulb has been left on by mistake, it can be turned off from the mobile phone's application. All 10 participants heard about smart TV, and most of them use it. Smart agriculture and smart textiles are not well-known domains. In the case of smart textile, more participants knew about fiber optic textile, which changes colors.

On a scale of 1 to 10, users rated 6 for the difficulty of IoT devices usage, usually they mention software issues and connectivity issues.

Regarding the mobile IoT technologies, all 10 users, who have confirmed they have at least one IoT device, have and use smart watches. Two of them have fitness bracelets and only one of them tried a T-shirt with sensors for measuring the pulse. The smart watch's price and design can vary, more and more manufacturers started to produce mobile intelligent devices. Through its connection to the mobile phone, the smart watch can offer many functionalities, becoming an interface for the mobile phone. The latest smart watches models have very good resolution and they allow Bluetooth connection to the mobile phone and other devices. Wearable devices are frequently used: four participants in our study said they use their smart watch daily, three said that they use it weekly and three of them occasionally. On a scale of 1 to 10, users rated 5 for how difficult it is to use wearables. They encountered some difficulties when the battery discharged. After the battery is recharged, some of the participants faced difficulties to run some applications. Some users mentioned that the mobile IoT devices discharge very fast, within one day, which is a slight disadvantage in use.

Current screens have good resolution, but older smartwatches screens have poor resolution. Yet, it is difficult to read information on the smart watch screen due to its dimensions, but larger than 2 inches screens would make the smart watches difficult to wear. Used to check information on larger screens, like laptops and tablets, it is a less pleasant experience to read information on a smart watch screen. The interface is not always easy to use, and synchronization with the mobile phone is often difficult.

We noticed that there are several common characteristics of the people who buy and use smart watches:

- *They have an active professional life*. Users are always on move, having various activities. They communicate a lot with friends, family and fellows. Smart watches help users check notifications when not possible on the phone, for example in meeting or in traffic. Usually users buy and use a smart watch which is compatible with their mobile phone. There are smart watches that work exclusively with the iOS operating system, such as Apple Watch. But if the phone is Android, then there are more compatible smart watches models and brands.

- *Users are passionate about sports*. The majority of users have weekly sport activities. For example, if they run and someone calls them during this time, the smart watch is perfect to answer or send a message. A mobile phone is not easy to wear during sport activities. A smart watch helps users view their training route or the number of steps. The view of maps or maps navigation is also very easy with such a device. He can monitor physical activities to evaluate physical performance and compare results at certain time intervals. In addition, during training the users could benefit from music, being very convenient to use.

- *Users are interested to receive specific information,* such as the pulse or calories burned. Smart watches help them to receive real-time information about their health. In addition, users receive information about sleep quality or moments of relaxation.

4. The impact of IoT technologies

We noticed a good knowledge of the participants in this study of IoT applications in certain fields. In general, they know better the IoT applications for end consumers, than the IoT applications dedicated to the business field. IoT technologies have a beneficial influence on their lives, helping them to reduce energy consumption, save time and money, and help them to make better decisions.

Based on the case study we identified several advantages of using IoT technologies:

- These IoT applications generate a large amount of data. Having more data, it is easier to make the right decision.

- It saves time - for example in the case of smart homes the users can control central heating or specific plugs, from the mobile phone application.

- It saves money - energy reduction in the case of smart home being well-known for participants în this study.

- Data archive has a special advantage for the decision-making process. Users can track and observe the evolution of an event/activity.

- Devices communicate more easily, with total transparency, reducing the number of issues. For this reason, users can make better decisions, based on real-time information.

We identify the following disadvantages:

- *Compatibility* - at present there is no standard for making and monitoring the sensors which are used in IoT devices.

- *Complexity* - the IoT projects are complex and require knowledge and experts from different fields, such as engineers, IT specialists, and project managers. The complexity of projects can generate errors and it is difficult to detect and solve the issue.

- *Confidentiality* - the information is not encrypted most of the time, so personal data can be accessed by unauthorized persons.

- *Security* - the IoT software could be accessed by unauthorized entities and personal data may be deliberately stolen. Security policies and documents that companies provide to describe how they manage consumer-collected data (Perez, Zeadally, Cochran, 2018).

IoT technologies have been successfully implemented in online social networks, offering the possibility to generate automatic posts. Activities such as likes or shares, can now be managed and activated automatically from special devices. At the same time valuable information about potential customers can be accessed and stored. Based on these, companies can make better decisions for their brands and promotional campaigns.

Smart watches users are usually part of online communities. There are many online communities talking about their performances, such as the number of steps per day, or about their experiences with IoT devices. Fitbit company developed a community with many common interests, such as sport events, healthy eating or challenges they faced using IoT technology.

Figure 2. Smart watch community (Fitbit.com)

IoT users are aware that retailer and consumer goods companies get richer insight into their shopping behavior. Video cameras and motion sensors provide intelligence about how the users move into a shop, what they select and how they spend time in a specific shop location. Geolocation for shoppers is also a popular IoT application. Tracking the shopper's smartphone, companies could personalize information and promotional offers.

5. Results and conclusions

IoT has been gradually bringing a lot of technological changes in our daily lives, which in turn helps to make our life simpler and more comfortable (Madakam, Ramaswamy, Tripathi, 2015). These technologies aim to provide people with innovative and intelligent applications and services where all the physical objects are connected to the Internet and communicate with each other (AlHogail, AlShahrani, 2018).

Most of the participants in the study knew several IoT technologies, such as smart homes (smart TV, smart plugs, smart light bulbs or smart heating), smart cities, smart cars or smart textiles. All interviewees have smart watches and two of them have fitness bracelets. A smartwatch becomes an interface for the smartphone, helping users to become more connected with family and with fiends. It is easier to use a smartwatch than a smartphone in traffic or during the meetings.

During the sport activities, they use the smartwatch to receive messages or to listen to music.

It is easy to use the IoT technologies, but there are more issues regarding it. Participants to the study said that first there are confidentiality and security issues, many of their data could be stolen by unauthorized persons. The success of IoT depends on the consumer perceptions about security and privacy in IoT and the level of digital trust of its consumers (Khan, Aalselem, Khan, Arshad, 2016).

IoT technologies are complex, and because of it is difficult to solve technical issues sometimes. At present, there are no standards for making and monitoring the sensors which are used in IoT devices. That's why a smartphone could not be able to connect to a specific smartwatch because there are different brands and standards. Usually users check forums and additional information, before they buy any IoT product.

We identified common characteristics of the people who use IoT applications and devices. People who use IoT devices have an active professional life, they communicate a lot with their colleagues and family. They participate in meetings and travel more than average. They are passionate about sports, having weekly sport activities, using the smartwatch to receive notifications and listen to music. They like to get information like the number of steps or stairs accomplished during a specific time or the pulse values. Usually the smartwatch users are interested in their health or sleep quality, receiving real-time information. Many IoT users are members of specific communities, having common interests, such as sports, healthy food, travel or technology.

There are important business implications regarding using the IoT technologies. IoT applications could generate automatic content in social media. Activities such as likes or shares, can now be managed and activated automatically from special devices. At the same time valuable information about potential customers can be accessed and analyzed. Based on these, companies can make better decisions and better marketing campaigns. Tracking the buyer's movements and interactions within specific stores, companies can personalize messages, offers and specific content for any individual. The analysis of IoT data performs as an information tool of future demand, offering the possibility to optimize marketing strategies and supply chains. In this context, all IoT applications should happen with respect for consumer's privacy.

Acknowledgment

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