INTERNET OF THINGS (IoT) APPLICATIONS STUDY USING BIG DATA AND VIRTUALIZATION PROCESS TECHNOLOGY.

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ABSTRACT

This paper is about the study about the Internet of things (IoT) applications using Big Data (or "data analytics ") and the virtualization process. The Internet of things is at the beginning, but is expected that in the near future will transform the world, creating a giant network of devices and machines globally connected, aggressively increasing communication and data exchange, the IoT is still seen as fiction, but in reality this world already exists through numerous devices present in our daily lives: the "wearables" (term meaning technologies to wear) like tablets, smartphones, smart watches and bracelets. With the use of IoT comes the solution of various problems, but through this intense communication another problem is created, the huge volume of collected data. This problem is being solved by Big Data, that handles structured and unstructured data.

Keywords: Automation, Security & Intelligence, Industrial Engineering, Internet Of Things

1. INTRODUCTION

The Internet of Things covers several technologies that have been developed in recent years, according to Ayres and Sales (2010), this is an expression used from the 90s relating the network connections between objects to the Internet, Figure 01. Technologies that guarantee much of its development are RFID[1] (Radio Frequency Identification) sensors, ubiquitous[2] wireless networks and the Internet Protocol change for IPv6 version.

Nowadays, the IPv4 protocol is the most used, and capable of generating up to 4 billion IP (Internet Protocol) addresses. In this case, different addresses can only be given to a limited number of computers, mobile phones and devices connected to the network. With Internet of Things, each object must have its own address. The solution to this obstacle is on IPv6. Through Ipv6 an almost unlimited amount of codes can be generated to a lot of objects, more precisely 340 undecillion objects.

[1] RFID technology (radio frequency identification) is nothing more than a generic term for technologies that use radio frequency for data capture. Therefore there are several methods of identification, but the most common is to store a serial number that identifies a person or object, or other information, in a microchip. Such technology allows automatic data capture, to identify objects using electronic devices, known as electronic labels, tags, RF tags or transponders that emit radio frequency signals to readers that capture this information. It exists since the 40s and came to complement bar code technology, widespread in the world.

[2] The term "Ubiquotous Computing" was originally stated by Mark Weiser in 1991, on his article "The Computer for XXI Century", to refer to devices conetcted everywhere so transparently to the human being, we will end up not realizing they are there.

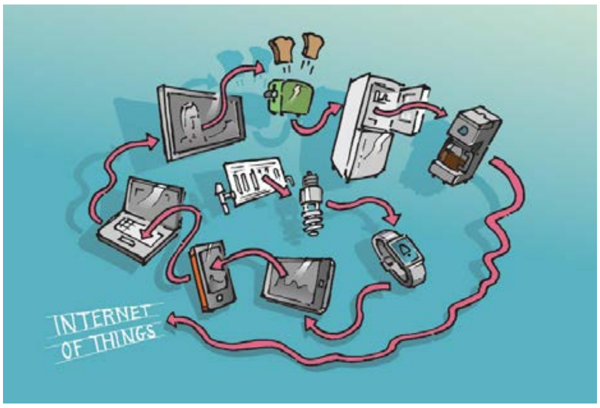

Figure 01 – Internet of Things (IoT)

In general, the Internet of Things (IoT) is an extension of the internet to the real world (physical) where a great interaction with objects and their independent communication between them become possible, however, according to Singer (2012), define what actually is the Internet of Things (IoT) is complicated in the face of several studies and publications on the subject. A lot of information stored on computers around the world is used on the Internet. This is a totally virtual world where people browse and interact with pages accessed via hyperlinks. On the Internet of things, objects have their own identification and this can be read in an automated manner. Physical objects are now represented in a virtual environment.

2. IoT CONCEPTS:

- Internet access;

- AIDC[3] (Automatic Identification and Data Capture);

- Context perception.

These three concepts allow the development of a fairly complete model of technologies needed for the creation and deployment of IoT (Internet of Things) services. Interest in this area is very large due to the potential this concept has to be applied for idealizing new business models. IoT is a very representative technological revolution regarding the future of computing and communications, its development depends mainly on technological innovation of nanotechnology and new wireless sensors. Advances in miniaturization processes and nanotechnology enable small objects to connect and interact.

The advantage of this vast amount of information integrated between various industrial products and everyday items only become possible through sensors that are able to identify environmental physical changes. These modifications allow static objects to be transformed into dynamic, adapting intelligence and stimulating the development of several innovative products and new applications. RFID (Radio Frequency IDentification) is the most promising technology in this regard, Figure 02.

According to the analysis of Kranenburg, 2008, p.62, which states:

> "Cities across the world are about to enter the next phase of their development. A near invisible network of radio frequency identification tags (RFID) is being deployed on almost every type of consumer item. These tiny, traceable chips, which can be scanned wirelessly, are being produced in their billions and are capable of being connected to the internet in an instant."

Figure 02 - Basic scheme of RFID use.

Most of these devices are already used in several countries including Brazil. Some of the benefits of the internet of things are:

- Identify and track assets and people;

- Check and improve process efficiency;

- Improve inventory control efficiency;

- Improve perishable products control;

- Reduce losses;

- Facilitate supply chain synchronization;

[3] Automatic identification and data capture (AIDC) refers to the methods of automatically identifying objects, collecting data about them, and entering data directly into computer systems (i.e. without human involvement). Technologies typically considered the part of AIDC include bar codes, Radio Frequency Identification (RFID), biometrics, magnetic stripes, Optical Character Recognition (OCR), smart cards, and voice recognition. AIDC is also commonly referred to as "Automatic Identification", "Auto-ID" and "Automatic Data Capture".

- Increase supply chain visibility;

- Reduce operational risks;

- Increase customer satisfaction and loyalty;

- Reduce theft and forgery;

- Get greater reliability in data management;

- Get accurate information for decision making;

- Meet the requirements for Retailers and Distributors;

- Check after-sales and warranty.

Through advanced nanotechnology development and internet penetration, the natural way is the connectivity of these RFID tags to the computer network and the information switching between them. IoT is an increasingly present reality.

Some applications that can be developed: subcutaneous health monitor warning your doctor or the nearest hospital of a heart attack risk; a product informing your health monitor of gluten, lactose or phenylalanine presence; smart refrigerators able to report the lack of food, find recipes on specialized sites and add products to the supermarket shopping list, and the user is able to approve and confirm it over the internet with a click. Objects themselves would be responsible for this interaction: a chip in the milk box, for example, warns the device of the proximity of expiration date; when the last beer is consumed, the device informs electronically it is necessary to buy more.

3. WEARABLES

There are devices called "Wearables"[4] (a term that refers to technologies to wear). This technology is being used mainly in “smart” watches and devices for sports practice, but there is much more about this technology. Manufacturers like Samsung, Intel, LG, Sony, Qualcomm and others, developed several wearable equipment, figure 03. The list of large companies that have developed innovations in this segment is quite representative. Also, a large portion of small industries have participated, desirous of finding even more specific purposes for developed microchips.

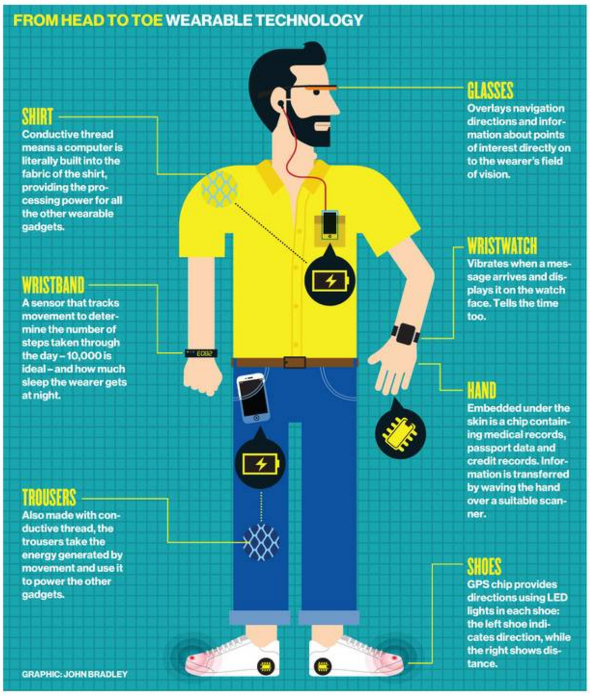

Figure 03 - Examples of Wearable devices.

Sony and Samsung went ahead placing on the market the “smart” watches SmartWatch 2, figure 4, and the Galaxy Gear, figure 5. Even though there is still a small share of users, these devices are increasing their use of technology possibilities, and more and more applications are developed for such equipment. Receive e-mail notifications, access Twitter[5] or even Facebook posts, remotely control the smartphone and start a car in the distance, figure 6, are just some of the possibilities.

The "smart" bracelets that have been released prior to the clocks found another way to help consumers monitoring their health. An example is the LG Life Band Touch, figure 7, which in addition to controlling smartphones can also monitor your heart rate. All collected data is transferred to the phone via Bluetooth, and through a specific application, it is possible to measure distances and even count steps, average speed and calories expended during use. This type of technology is increasingly diverse and present in our daily lives.

[4] Wearable computers, also known as body-borne computers or wearables are miniature electronic devices that are worn by the bearer under, with or on top of clothing. This class of wearable technology has been developed for general or special purpose information technologies and media development. Wearable computers are especially useful for applications that require more complex computational support than just hardware coded logics.

[5] Twitter is a social network and server for microblogging, which allows users to send and receive personal updates from other contacts (texts up to 140 characters, known as "tweets") via the service website, via SMS and specific software management.

Figure 04 – Sony SmartWatch 2.

Figura 07 - LG Life Band Touch.

Figure 05 – Samsung SmartWatch Galaxy Gear.

Figure 06 – Starting the car with the SmartWatch.

4. FORECASTS FOR IoT

Cisco[6] made a preview about the growing number of devices per person, based on a study in China which came to the conclusion that in 5.36 years (2001-2006) the number of devices doubled. Thus it is estimated that in 2020 we will have a world population of about 7.6 billion people and 50 billion devices connected to the Internet, figure 08, this generates an average of about 6.58 devices per person. (Evans, 2011).

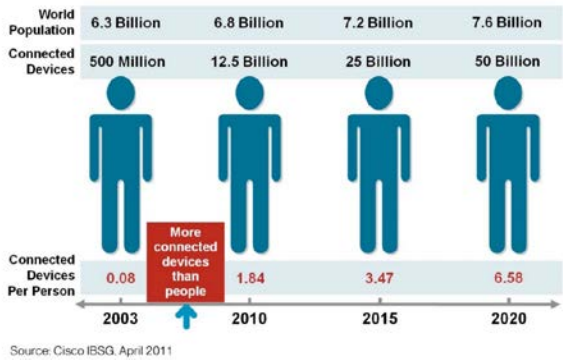

Figura 08 - The Internet of things was "born" between 2008 and 2009.

The greatest effect of all this is a large increase in variety of devices, various possibilities that are unknown even to the industry. The most obvious items, not coincidentally, are the ones that are first delivered to the public: "smart" bracelets, watches and glasses now have their own processors and have the ability to integrate and interact easily to tablets and smartphones.

[6] Cisco Systems, Inc. is an American multinational technology company headquartered in San Jose, California, that designs, manufactures, and sells networking equipment. The stock was added to the Dow Jones Industrial Average on June 8, 2009, and is also included in the S&P 500 Index, the Russell 1000 Index, NASDAQ-100 Index and the Russell 1000 Growth Stock Index.

The industry estimated sales projection is 171 million units by June 2016. Devices probably will enter the market in extremely different ways, reaching in several ways our personal lives, from health services to fitness, from well-being care to medicine, including sectors of entertainment and information.

Technological dimension is highly insufficient for understanding the world of IoT and to build roadmaps representing realistically and adequately how to forward efforts and investments in research and development to enable everyone, as soon as possible, to use the benefits IoT can provide.

Brazilian industry uses this system in several projects, mainly through application with the RFID technology. The most common segments in the market with troubleshooting focus are:

- Consumer Goods have more traditional solutions with technology use in supply chain;

- Logistics with focus on traceability solutions and urban mobility;

- Industry focused on productivity solutions;

- Services focused on quality solutions for providing services to clients;

- Entertainment focused on innovative solutions and integrated experiences for consumers;

- There are several initiatives which stand out in the areas of education, health, and safety, and the combination of safety with other technologies consists of high value-added projects.

5. USE OF BIG DATA IN IoT

The term Big Data[7] is fairly new, emerging around 2005 with Google and increased greatly in 2008 with Yahoo, who changed the Hadoop platform and to turn it into Open Source.

When someone hears the term Big Data, immediately comes to mind a literary translation of the text "Big data" related to the huge amount of data to be analyzed.

[7] Big data is a broad term for data sets so large or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization, and information privacy. The term often refers simply to the use of predictive analytics or other certain advanced methods to extract value from data, and seldom to a particular size of data set. Accuracy in big data may lead to more confident decision making. And better decisions can mean greater operational efficiency, cost reductions and reduced risk.

But the term is much broader, Carlos Barbieri (2013) states that Big Data is commonly classified by 5V's, that identify its five premises:

- **Volume**, relates the large amount of data inside and outside the company;

- **Velocity**, every second a lot of new data is created on the Internet, and some of this data may be of interest to one´s company;

- **Variety**, the data may be a blog post sharing, a text in a social network, an e-commerce review, etc.

- **Veracity**, collected and mined data should have authenticity;

- **Value**, as it is important to have return on investment.

With the evolution of IoT applications and the increasing need for information, more and more applications are being developed, continually increasing the amount of information. The growth of data in enterprise applications annually is of approximately 60%. It is estimated that a company with a thousand employees can generate annually about 1,000 terabytes, and this number tends to increase fifty times by 2020. With this significant increase in applications, information is generated exponentially, thereby manageability of these information becomes essential for these applications.

5.1 BIG DATA CHALLENGES

The biggest challenge of Big Data is to manage a large volume of data and mine this information in a shorter request. An excellent strategy is to make the application grow as it is required, using thus a vertical scale (the power of the hardware is increased by increasing memory and processing of a single machine) or horizontally (where the number of machines is increased). Although it is more complex, the horizontal scalability ends up being very cheap, and it is easier to grow or shrink resources according to demand.

An aspect rarely discussed in Big Data, is related to the speed in the software development and the speed of modeling. One example is Twitter where many users use the hashtag[8] ('#' added together with a word) and when searching for that hashtag will then present each message that has been tagged with it.

In conclusion, the concept of Big Data is extremely easy, even diverging from various sources, which is to carry out the management of a huge amount of memory extremely quickly.

6. FINAL CONSIDERATIONS

The Big Data technology is a modern tool of Predictive Management and Analysis, bringing great gains and benefits to different areas, whether private or public. The future will be much more challenging and productive by utilizing the Internet of Things, since this technology makes the Internet connection to everyday objects possible: household appliances, televisions, automobiles, etc. To provide smart environments, IoT will revolutionize our lives as consumers.

Big Data allows integrating high volume of data in IoT with data from companies' owners. This will allow a deep insight into customer behavior, especially regarding usage of a product. In the automobile industry, automakers will be able to learn about the real mileage of the vehicles, the driver´s driving style, if the drive more on the road or in urban areas heavy traffic. Thus, the returns will be much greater enabling a relationship that will attract the customer to do maintenance and reviews more effectively. The possibilities of joint action creation will be almost limitless among auto parts manufacturers and dealers, offering at the right time, replacement of the product with the right solution to the problem, helping the customer he is close to replace his vehicle and through the information obtained, offer a more appropriate model to his needs, and a bank loan plan according to the customer's financial conditions and thus increasing customer loyalty.

The conclusion is that without Big Data it will not be feasible to have the Internet of Things, as one depends intrinsically on the other. For Ayres and Sales (2010) the concept of the Internet of Things (IoT) had its beginning at MIT (Massachusetts Institute of Technology) at the 1999 AutoID Center program. Today the world's leading Internet of things research and development centers are the Massachusetts Institute of Technology (MIT), the precursor in the United States, and the University of Manchester in England, where the annual conference "The Future of Things " is hosted.

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