Customer data collection with Internet of Things

Agnieszka Bojanowska[1,*]

[1]Lublin University of Technology, Faculty of Management, Marketing Department, Nadbystrzycka St. 38, 20-618 Lublin, Poland

Abstract. The purpose of this paper is to present the potential of Internet of Things (IoT) for customer data collection for Customer Relationship Management (CRM) systems. The Internet of Things technology finds numerous applications in company operations ranging from scheduling production tasks to supporting marketing activities. This article discusses the possibility of using Internet of Things to collect customer data. Examples have been presented that will allow detection of some dependencies between the use of this technology and the quality of received data, which may be subjected to analyses, *inter alia*, in the CRM system. There are also examples of solutions that can be successfully used by enterprises that want to process and analyse data about their clients and have difficulty in obtaining this data.

1 Introduction

Companies operating today must use the latest technologies and management methods in order to win a continuous race against the competition. To increase competitiveness, most companies already use methodology, philosophy and Customer Relationship Management (CRM) technology. The success of CRM is based primarily on the conclusions that companies draw from data obtained about customers. CRM allows managing a large amount of customer data, enabling *e.g.* predicting the rotation of customers, the demand for a new product, or analyse the response to a marketing campaign. Admittedly, companies are reaching and will reach for what newer and better ways to collect data about their clients because from their processing comes knowledge necessary for the functioning of the enterprise on the modern market. Along with the development of the Internet and the latest technologies, the possibilities offered by Internet of Things (IoT) also appear in this area. In addition, customers themselves are becoming more demanding and rarely loyal to one company. Collecting data needed for the CRM system becomes difficult and requires many inputs and efforts from companies, particularly given that the scope of relevant data is still widening. It can be assumed that the greater the amount of data, the harder it is to develop; however at the same time the results are more accurate, and therefore the business decisions are made with a higher degree of certainty and increase competitiveness.

The aim of this paper is to present the IoT concept in the context of the possibility of using it to collect customer data for CRM systems. Any possible applications and solutions using IoT have been presented, which the author proposes in this matter based on practice and theory. The research method used in this article is self-observation, literature study and virtual ethnography.

2 The essence of Internet of Things in the context of data collection

IoT allows people and things to be connected anytime, anyplace, with anything and anyone, ideally using any path/network and any service [1]. Internet of Things does not really focus on things, but on data that is collected through broadly understood *things*. This term can be explained as a concept according to which physical objects are connected in networks, have constant access to Internet and can collect, process or transfer data to each other independently or in groups(...). The name "Internet of Things" was first used by an entrepreneur and creator of start-ups Kevin Ashton [2] in 1999; currently, it is one of the most important dates for technology [3]. There are many definitions of Internet of Things. According to the Cisco Internet Business Solutions Group (Cisco IBSG), Internet of Things began the moment the number of items and objects connected to Internet exceeded the population. In 2000, there were 6 billion people in the world and only 500 million devices were connected to the network. At the turn of 2008, the number of devices connected to Internet for the first time exceeded the number of inhabitants of Earth, which marks the point when Internet of Things was born (Fig. 1) [4].

Collecting data via Internet of Things can be done through multiple channels and many methods (Fig. 2), for example, using Internet of Things to manage the city, in advanced monitoring systems and using intelligent sensors.

As a result, data is collected and analysed real time, supporting the management decision making. Billions of devices that create Internet of Things will generate huge amounts of data in a very short time. All data and information provided by *things* should be collected for further analysis and processing. In the first place, data must be provided – it is usually done *via* wireless

* Corresponding author: a.bojanowska@pollub.pl

technologies, which are much slower and more unreliable than cable communication systems, so there may be problems with bandwidth and transmission reliability [6].

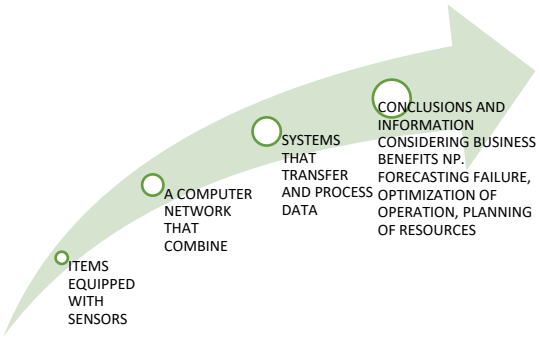

Fig. 1. The functional idea of Internet of Things solutions [5].

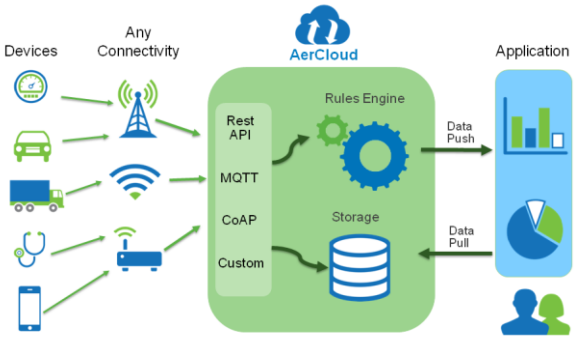

Fig. 2. Collecting data *via* Internet of Things [7].

It is estimated that in 2020, the number of devices connected to the network will exceed 25 billion. Internet of Things is finding new applications in many areas. Nowadays, the scope of applications of this technology is significantly expanding and it is used in more and more new areas (Fig. 3). Until now, this technology has been applied in the following areas:

– home appliances and multimedia,
– intelligent home,
– security systems,
– health and life protection systems,
– marketing in retail trade,
– production systems,
– logistics,
– other applications, in breeding and plant cultivation [8]

Here are some more examples of the impact IoT has on industries:

– Intelligent transport solutions speed up traffic flows, reduce fuel consumption, prioritise vehicle repair schedules and save lives.
– Smart electric grids more efficiently connect renewable resources, improve system reliability and charge customers based on smaller usage increments.
– Machine monitoring sensors diagnose – and predict – pending maintenance issues, near-term part stockouts, and even prioritise maintenance crew schedules for repair equipment and regional needs.
– Data-driven systems are being built into the infrastructure of "smart cities," making it easier for municipalities to run waste management, law enforcement and other programs more efficiently [9].

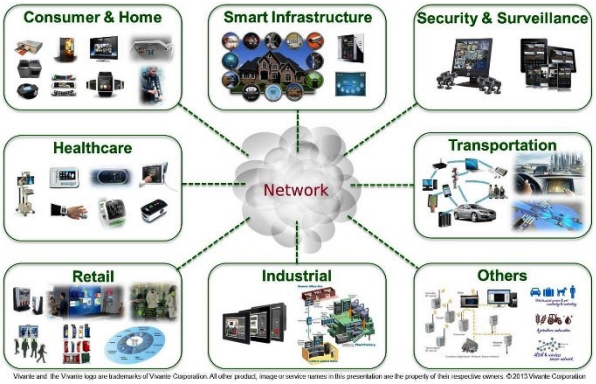

Fig. 3. Potential areas of application of Internet of Things [10].

The main changes brought about by Internet of Things are the dematerialisation of Internet (you will not have to "enter" it because it will "live" around us), hyper-personalisation (products and services, as well as marketing messages will be dedicated individually to each of us, at the expense of our privacy), and the hybrid world, or the penetration of the virtual network and the physical world. [11] The benefits of IoT solutions include: cost reduction, increased employee productivity and safety, better capital allocation, and improved customer relationships [5].

3 Customer data collection in theory

The assumption that the greater the amount of data, the harder it is to develop, but it translates to more accurate results, makes us look for new technologies to collect and process data. For example, the function of calculating the probability of customer departure from the company may require from about 5 to about 30 data, and of course, the more of them, the more accurate the prediction of customer behaviour providing long-term customer relationship. Customers are the primary resource and the driving force behind any business. That is why keeping a customer has great economic value. Leads can be pushed to new levels with the help of IoT-connected devices. However, that will not be of much help if there is no robust CRM platform for that information to go into [20].

Clients are reluctant to share their data. They usually have to get something in return. Contemporary marketing and CRM balance on the edge of ethics when acquiring, using and processing data. Companies are reaching for newer and more "tricky" solutions in this matter. For example, activities in the field of neuromarketing are undertaken, which allow us to learn even the subconscious needs of clients. Not always customers are properly informed about the reasons for collecting data, especially when it comes to qualitative data, such as consumer behaviour. Today's clients are becoming more aware of their rights, but often do not realise the scale of data processing and its use for CRM and marketing. All data collection solutions should allow

maintaining ethical standards at the highest possible level; this results in customer trust and loyalty. In addition, data security issues are important. Security is one of the major concerns in our society, and in this respect, IoT systems are involved from two different points of view. Firstly, the pervasiveness of the IoT deployments will imply that trillions of objects will be observing us in our daily activities; these must be designed so that the collected data is used in the most reliable and secure way. Secondly, IoT systems themselves will be used as an effective tool in support of the security of our society as the connected smart things should be able to collect data about malicious behaviours in both the digital and physical worlds [12].

The nature of data collected, processed and used in CRM systems has been undergoing successive changes over the years. The needs of CRM system users are changing. Initially, measurable data were collected which were often were collated with demographic data such as age, gender, education, and client's earnings. Later, the scope of data for CRM was extended to include qualitative and behavioural data, such as the lifestyle of customers, their needs and preferences. In most cases, the collection of data takes place through interaction with clients and it is they who usually provide or verify this data. There is a basic problem here: the data provided by the customer may be falsified in a conscious or unconscious way. Part of the data in CRM systems came from observations made by employees. Nevertheless, they are often burdened with a subjective assessment of the situation and its incorrect assessment resulting from ignorance of the customer's behaviour context. For CRM systems that have the task of getting to know the customer the best, matching the offer to them and establishing a long-term relationship with the customer, such data is once again less reliable, so new solutions are still being sought after.

A certain idea of data collection for CRM systems can be guided by the idea of neuromarketing research. At the heart of neuromarketing lies the assertion that customers make purchase decisions in 95% unconsciously [13]. Numerous neuromarketing studies often show that declarations made by the client do not always translate into decisions made by him. For example, clients declare that they do not react emotionally to social advertising, while the EEG study during advertising emission indicates a clear emotional involvement of the respondent.

For the above-mentioned reasons, one should consider the possibilities offered by Internet of Things in relation to the collection of data on customer behaviour. Thanks to this technology, the emotional and subjective involvement of an employee collecting data is avoided preventing the falsification of data by the clients themselves (both conscious and unconscious). It can be assumed, therefore, that data obtained *via* Internet of Things will be the best material for further analyses in the CRM system. It is even claimed that IoT will give new life to CRM systems [14]. Internet of Things makes it possible to immediately transform data into decisions.

4 Examples of using Internet of Things to collect customer data in practice

Managing customer relationships, in line with the CRM system, focuses on achieving a greater individuality of clients. The data needed for this goes beyond the traditional understanding of demographic segmentation. In fact, data about customer behaviour overlap with demographic data, such as age or gender of clients. Sometimes you can find some repetitive behaviour patterns. For example, neuromarketing research suggests that women pay more attention to smell when shopping and distinguish more aromas.

Internet of Things provides information on customer behaviour in real time. The company can react immediately to customer behaviour. The question is, what solutions to use. It is possible to "track" customer behaviour:

- through the possibilities offered by the application installed on the client's mobile device;
- through devices installed in the company's headquarters or *e.g.* in a supermarket sales hall;
- by linking the two previous solutions with the so-called beacon.

4.1 Collecting data for the purposes of behavioural segmentation through customer's mobile devices

In the case of data collection *via* a mobile application, the client must first be encouraged to install the appropriate program, which can also be used, for example, as a loyalty program. The customer must also agree to track their location by the application and possibly to send notifications by the application (it is not necessary to collect data). According to the law in force, customers must know what the nature of the data transmitted about them by the mobile application is.

Once the client already has the right application, they send huge amounts of information that indicate certain patterns of the customer's behaviour, by logging in at certain locations over time it indicates their lifestyle. For example, regularly logging in to an eco-friendly store around 10 am on certain days of the week, in conjunction with other data, may indicate a person who runs a regular lifestyle and goes shopping for the family, running a healthy household. With a certain probability, it can be said that the person will be interested in healthy food, that they are systematised and that they make well-thought-out purchase decisions. Another picture of the customer can give us information that the client stays outside the house during the night hours, *e.g.* by visiting dance clubs.

Mobile applications offered by companies often offer various promotions and discounts. If the application is associated with the purchase process, *i.e.* its code is read at the cash register, then you can examine the sensitivity of a specific customer for a promotional message. There are customers who make purchases only during the specified promotion period. For example, they enjoy using the 2 + 2 promotion for cosmetics, but they are not tempted by the 40% discount offered on the same range. Thanks to the data collected *via* Internet of Things, sales

teams can estimate the adoption of the planned promotion by customers and, for example, limit or extend its range or time. This is very important for marketing CRM.

4.2 Collecting data about customer needs and preferences by devices installed in a store or company *etc*.

Monitoring in stores and retail outlets has long ceased to fulfil only safety-related functions. Customers can be observed by stores for the purpose of collecting data not related to their personal data. It is possible to analyse these data, and the information resulting from them allows for taking various business decisions and planning advertising and promotional campaigns. From the point of view of the CRM system, it may be relevant, for example, how men and women are moving around the store. It is also important to which shelves customers reach more willingly.

Amazon is the leader in collecting customer data online. They use experimental solutions that also allow customers to make purchases in more convenient conditions for the tidy self-service. The system, which Amazon used, is simple and uses sensors installed in the store, registering what products are taken off the shelves (or postponed when changing the decision) by customers while shopping [15]. This experiment brings a lot of information about how customers make purchasing decisions, and it enables checking the correlations between many variables. It is possible, for example, to determine the rate at which the purchase decision is made in relation to the client's characteristics (age, sex, *etc*.) for different types of products.

Examples of the possibilities of collecting customer data in the store are shown in Figure 4 below. It can be assumed that in the near future sensors working under IoT will revolutionise self-service retail.

Internet of Things will also open before retail trade a lot of cross-promotion between brands. The intelligent fridge notifies you of the deficiencies not only of the shopping application on your smartphone, but also specific brands that will add your product as a recommendation on the shopping list and send an appropriate notification to the refrigerator screen [11].

Neuromarketing research suggests that customers (not just grocery shoppers) are attracted and encouraged to buy, *inter alia* by the smell creating the right atmosphere for shopping. Therefore, it seems advisable to use Internet of Things to gather information about whether customers like the smell of the store. This could be achieved by installing cameras at the source of the fragrance (*e.g.* in a grocery store near the bakery) and observing the mood of the customers. Of course, appropriate software can be used to generate and identify moods. There may be a problem of analysing the whole picture and extracting from it the necessary information about the mood of the person depicted in the photograph or the frame. For locating a face, you can use, for example, the Haar classifier, which is available together with the OpenCV image processing library [21]. Then you can narrow down the search area of the mouth to the part of the photo, depending on the size of the area recognised by the classifier as a face. After identifying the face, you can go on to analyse the mood that it expresses. This is the place to use neural networks.

4.3 Collecting customer data through beacons

One of the more recent and more interesting solutions within Internet of Things are the so-called beacons. Beacons have been generating buzz since 2013, when Apple first introduced iBeacon technology. Apple explains iBeacon technology to consumers as the enabling technology for Apple devices to alert apps or websites (which the user has opted into) when someone approaches or leaves a location. In other words, retail or other venues that have beacons in place can detect where a customer is at any given moment [18]. This is a solution that develops the possibilities offered above by the data collection for the purposes of behavioural segmentation through customer's mobile devices.

The retail is probably the most often cited example of an industry employing beacons, with heavy hitters like Macy's and Lord & Taylor deploying them in their stores. However, retail represents just one of many kinds of businesses that can benefit from beacons [18].

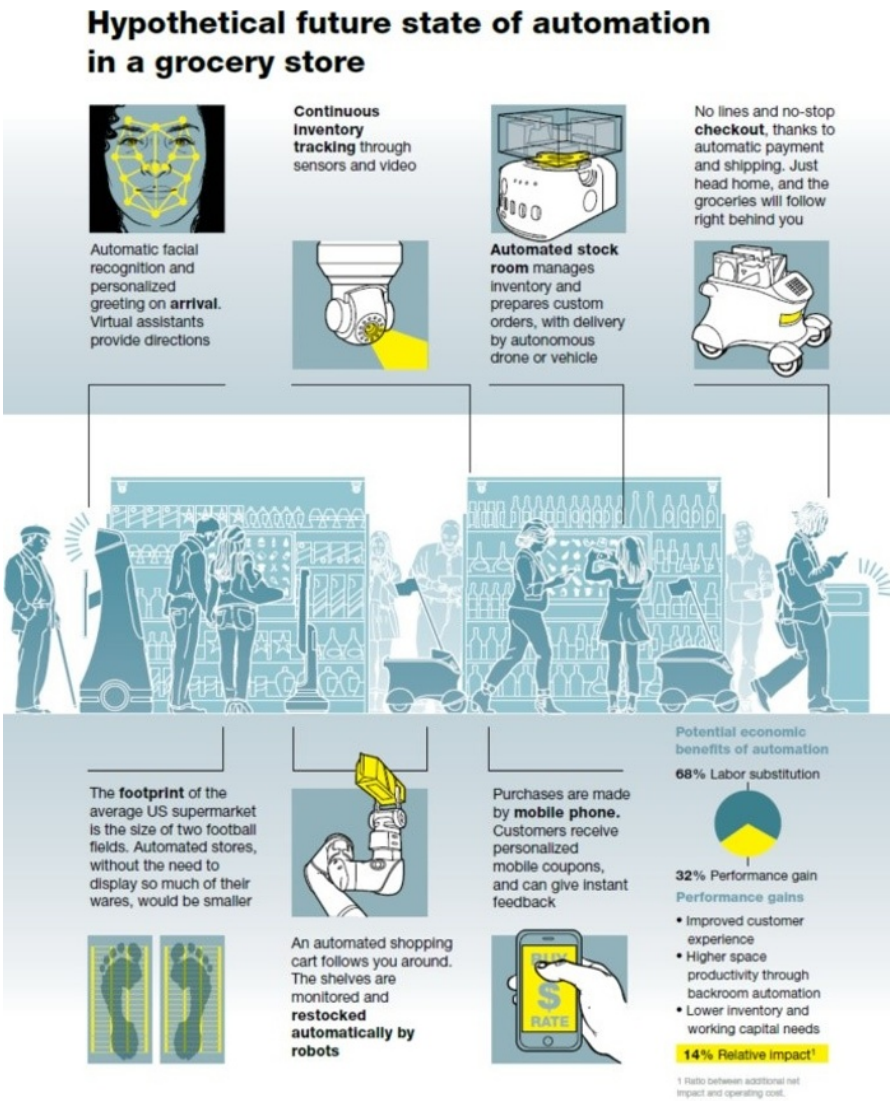

Fig. 4. Examples of collecting customer grocery store data using sensors [17].

Beacons operate differently than the previously proposed NFC, which they are supposed to slowly replace. They use Bluetooth 4.0 BLE for operation, consuming very little energy, which is a huge advantage because more and more smartphones - iPhones from 4s up or Samsung Galaxy S 3 up - have Bluetooth 4.0 [16]. Beacon (Fig. 5) is a compact device consisting of a Bluetooth chip and a battery. The transmitter sends out a specific signal, which compatible devices recognise as three numbers - UUIDs that usually identify the type of service and two additional numbers responsible for recognising the function. For example, the Beacon of one store chain may have one UUID number that will recognise the application, but they can also send two additional numbers, which will trigger different functions within one application. Beacons enable collecting experience about the behaviour and needs of the client for the needs of the CRM system. At the same time, the data dissemination initiative remains on the side of clients.

5 Summary

The concept of Internet of Things, as seen in the examples mentioned above, perfectly complements the concepts and technology of CRM. This support is obviously at the technical as well as functional level. The goal set at the beginning of this article has been achieved. The above considerations can be further developed in subsequent articles.

Internet of Things seems to be the next natural step in the evolution of the Internet and ways to use it. It is also an innovative solution in the world of information, knowledge and data management. Implementation of this solution to any system that needs quick access to current and reliable data would not come as unexpected. Systems of CRM are also such systems.

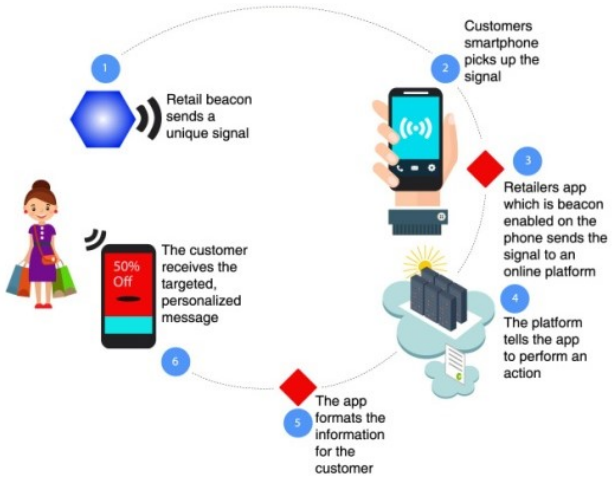

Fig. 5. The method of operation of beacons [19].

The paper presents only three possibilities of using Internet of Things for the needs of CRM systems. These are collecting data for the purposes of behavioural segmentation through customer's mobile devices, collecting data about customer needs and preferences by devices installed in a store or company *etc*, and collecting customer data through beacons. Each of these solutions brings numerous opportunities as well as threats. They can be and often are limited by the law and the protection of customer privacy. Some insufficiency may arise from the lack of description of specific results of IoT applications for the methods highlighted in the article. This should, however, be understood in the context of the limited volume of the article. This article is the beginning of a series of articles summarising the results of research in the field of information technology in CRM applications.

References

1. H. Sundmaeker, P. Guillemin, P. Friess, S. Woelfflé, (Eds) *Vision and Challenges for Realising the Internet of Things* (European Commission, Information Society and Media, Brussels, 2010)
2. K. Ashton, RFID Journal **22**, 7 (2009)
3. Z. Zalewska, https://marketingibiznes.pl/biznes/internet-rzeczy/
4. E.M. Kwiatkowska, Internetowy Kwartalnik Antymonopolowy i Regulacyjny **3**, 8 (2014)
5. M. Grodner, W. Kokot, P. Kolenda, K. Krejtz, A. Legoń, P. Rytel, R. Wierzbiński, *Raport Internet rzeczy w Polsce* (IAB.Polska, 2015)
6. http://obserwatoriumict.pl/site/assets/files/1059/internet_rzeczy-wybrane_zastosowania.pdf
7. AerCloud™ – M2M Cloud Platform / IoT Platform from Aeris Communications, https://www.semiconductorstore.com/blog/2017/AerCloud-M2M-Cloud-Platform-IoT-Platform-from-Aeris-Communications/2210/
8. J. Lipski, J. Pizoń, Możliwości zastosowań technologii internetu rzeczy... (Oficyna Wydawnicza PTZP, Opole, 2016)
9. Internet of Things (IoT). What it is and why it matters, https://www.sas.com/en_us/insights/big-data/internet-of-things.html
10. J. Lipski, Internet rzeczy w zastosowaniu... (Oficyna Wydawnicza PTZP, Opole, 2015)
11. M. Górazda, https://interaktywnie.com/okiem-eksperta/jak-internet-rzeczy-zmieni-biznes-i-marketing-252575
12. L. Atzori, A. Iera, G. Morabito, Ad Hoc Networks **56**, 122-140 (2017)
13. G. Zaltman, How Customers Think... (Harvard Business Review Press, Harvard, 2003)
14. F. Palermo, https://www.cmswire.com/cms/internet-of-things/a-new-frontier-for-crm-the-internet-of-things-029120.php
15. Internet rzeczy już..., http://forsal.pl/artykuly/1109240,internet-rzeczy-juz-zmienia-biznes-oto-najlepsze-przyklady.html
16. E. Lalik, https://www.spidersweb.pl/2014/01/beacon.html
17. J. Hadall, http://www.jeremyhadall.co.uk/five-case-studies/
18. H.O. Maycotte, https://www.forbes.com/sites/homaycotte/2015/09/01/beacon-technology-the-what-who-how-why-and-where/#5cf1d5b51aaf
19. What are beacons?, https://www.happiestminds.com/Insights/Beacons-technology/
20. O. Lukavetska, How to Use the Internet to Improve Your CRM Experience, https://www.infusionsoft.com/business-success-blog/sales/crm/internet-of-things-and-crm
21. W. Paluszyński, Rozpoznawanie emocji na podstawie zdjęć ust. Smile or not Smile - SornS, http://sequoia.ict.pwr.wroc.pl/~witold/aiarr/2007_projekty/sorns