Smart Cart: When Food Enters the IoT Scenario

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Abstract. People barely know what they eat and drink: product labels are written with small characters and with a difficult terminology. As a result, people spend too much time reading labels or avoid reading them at all. To connect food data with people we design of a food IoT (Internet of Things) scenario, where a smart cart tells us if the food product we are about to buy meet our preferences or not. In particular, we first perform a real-world study to understand consumers' behavior while they shop; then we design a food IoT scenario and we use current technologies to investigate its feasibility. Results show that people would appreciate a tool able to help them connecting with food data and also show that current technologies are sufficient to create a food IoT scenario.

Keywords: Internet of Things · QR-code · Food shopping

1 Introduction

Today's society is very different from the one of our parents: the advances in technologies changed almost every aspect of our life: from private to public relations, from professional to entertainment activities, from shopping to vacation. We live in a scenario where people and data are more and more linked, where people are informed about everything and in real-time [1–4]. However, if we take a detailed look at the food scenario, we can observe that it is quite similar to the one of our parents: we go to the supermarket (either physically or virtually), we put products in the cart, we check out and pay. Technologies facilitate the payment, allow grocery shopping chains to know consumers, but consumers know almost nothing about the food they buy [5].

The lack of knowledge about the food may lead to health problems: according to the World Health Organization, more than one-third of adults are overweight and several diseases are directly connected to unhealthy diet [6] with people eating too much fat, too much salt, too little fruit and vegetables [7].

In this paper, we imagine a scenario where consumers and food are connected, where food data (e.g., ingredients, nutritional fact, etc.) are easily available to consumers to make them aware of what they buy, eat and drink. In particular, we explore the potential of Internet of Things to make food data easily available to consumers: we want to give them information that may lead to an healthier lifestyle and might prevent health problems.

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Think about the following scenario: Alice is very careful about what she buys because her daughter is allergic to nuts, her husband is on a diet that forbids him to eat food that contains more than 20 % fat, she wants to buy fruits and vegetables produced in area where she lives. Until yesterday, food shopping was a nightmare: for every product Alice had to read the label (sometimes with characters so small that Alice needed to put on her eye glasses), but today Alice is in an IoT food scenario, where things communicate each other through technologies like RFID, NFC and QR-code. In this scenario, Alice uses a smart shopping cart that takes care of everything: it communicates with product labels and, knowing Alice's preferences, it tells Alice whether she should buy or not that product.

The contribution of this paper is twofold: (i) check if the IoT food scenario would be useful to consumers and (ii) design and test an IoT food scenario with current technologies. The former is achieved through a real-world study and the latter is achieved through the employment of QR-code technology and through the development of a prototype application able to connect food data with people. Results obtained from the real-world study show that people are very interested in what's inside a food product, and the developed application shows that current technologies allow connecting food products with consumers. As a result, the designed IoT food scenario will likely increase the knowledge about what people eat an drink and will likely help people to eat healthier.

The paper is organized as follows: in Sect. 2 we present related works in the area of Internet of Things and food; in Sect. 3 we present the real-world study about consumers' behaviors, the IoT food scenario and the prototype application to be used in this scenario. Conclusions are drawn in Sect. 4.

2 Related Work

The Internet of Things will create a huge interconnected ecosystem that will probably cause a profound transformation of human activities and production processes. Several scenarios will be affected by this new technological revolution and the food scenario will likely be one of these [8].

In the literature, different studies focused on IoT food scenario. Fabian et al. [8] considered to couple every object with RFID tags in order to uniquely characterize objects with the idea of building a global network where to retrieve information like nutritional advice. Ren et al. [9] showed that RFID will allow to access messages during the entire life cycle of the product (e.g., state of preservation). Kouma and Liu [10] analyzed possible benefits of using QR-code in food products and depicted a possible scenario where the "on-line" food can be used to prevent obesity. Briseno et al. [7] proposed a mobile health platform intended to increase children's health awareness by using QR-code in food products. Jia and Yang [11] proposed to use IoT to build a food quality supervision platform.

3 Our Smart Cart Proposal

The motivation behind our study is to investigate whether an IoT food scenario would be appreciated and useful to consumers when they buy food. Indeed, nowadays, the only possible connection between food data and consumer is done through the reading of the product label, but this process is time consuming and might be annoying (think of the small character size used in many labels). However, there may be different reasons to read labels: a consumer may be on a particular diet, may want to avoid particular food (e.g., for intolerance reasons, for ethical reasons, etc.) or may want to pay attention to particular ingredients (e.g., saturated fat, sugar, etc.) and the knowledge about the products may result in an healthier eat.

In the following we analyze in details the contributions of this paper: (i) understand consumers' behavior when they shop and (ii) design an IoT food scenario and develop a prototype application to test its feasibility.

3.1 Customers' Behavior

To investigate the customers' behaviors we considered a real-world study and we asked for voluntary participation. We have been contacted by 205 people (76 % women and 24 % men) of different age (35 % of the participants is between 18 and 25 year-old, 43 % is between 26 and 35, 15 % is between 36 and 54 and 7 % is older than 55 year-old).

The first group of questions investigates the reasons people buy specific items. Results (multiple answers were possible), reported in Fig. 1, show that for 69.3 % of the respondents the most important aspect is the price; 50.2 % thinks of ingredients; 49.8 % checks the expiration date; 47.8 % is interested at the product origin; 21 % checks for nutritional value and only 20 % considers the brand.

The second group of questions investigates if people read product ingredients while they shop. Results, reported in Fig. 2 (left), show that 74 % of respondents

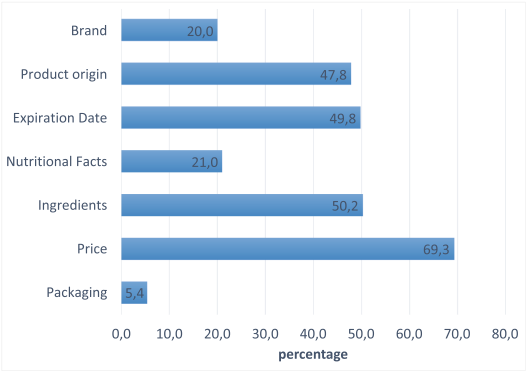

Fig. 1. Main reasons to buy a product (multiple answer were possible).

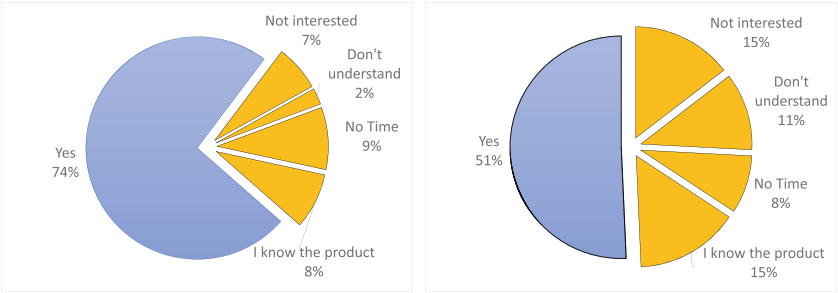

Fig. 2. Label reading: ingredients (left) and nutritional facts (right)

read the product ingredients, whereas the 26 % does not. Among the ones who read labels it emerged that 10.8 % has food intolerances; 15.3 % is on a diet (either for healthy reasons or for some disease) and 67.5 % is concerned about some ingredients (e.g., 3.6 % is concerned about sugar presence; 30.4 % is concerned about vegetable oils; 8 % checks the presence of saturated fat; 58 % wants to avoid specific ingredients like lactose, gluten or aspartame). Among the ones who do not read labels, 38 % of respondents do not have enough time to do that; 34 % already identified the products suited to their needs; 28 % is not interested in what is written on the label, and 10 % do not understand labels.

The third group of questions investigate if people read product nutritional facts while they shop. Results, reported in Fig. 2 (right), show that 51 % of the respondents read these values, whereas the 49 % does not. Among the ones who do not read the nutritional facts, it emerged that 32 % of the respondents already identified the products suitable to them; 32 % is not interested in nutritional facts; 25 % does not understand these data; 19 % does not have enough time to do that.

Finally, we investigated if people would appreciate a tool to help them reading product labels. Results showed that 69 % of respondents would like to have this help and would make use of this device if available.

3.2 Smart Shopping Cart

From the technological point of view, an IoT food scenario can be realized with several different technologies like for example RFID, NFC and/or QR-code. Since the employment of RFID and NFC technologies may require a structural investments (e.g., products equipped with RFID) that may discourage food producers and/or food vendors, we consider the use of QR-code technology. This means that the product producer has to print a QR-code on the label of the product (with product information, or with a link where to find these information, encoded in it) and the food store has to provide a tool (e.g., a smart supermarket cart or a mobile application) able to read the QR-code, to access to the product information and to check if the product meets the consumer's preferences or not.

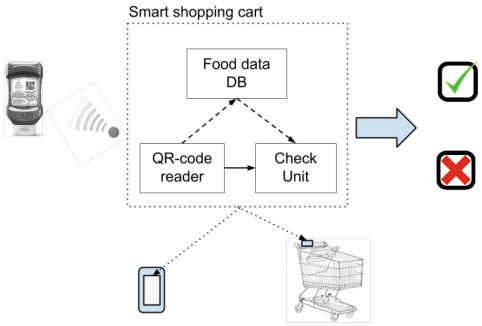

Fig. 3. The smart shopping cart architecture.

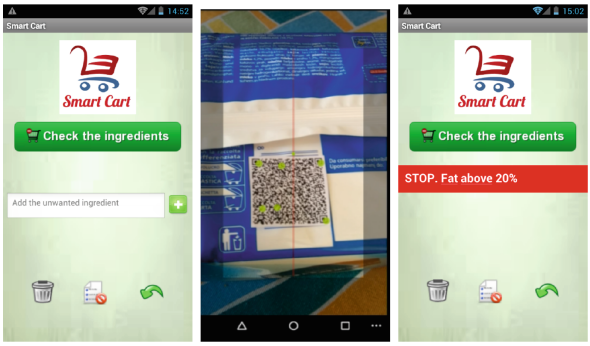

Fig. 4. Smart cart: the interface (left), QRcode reading (middle) and app warning (right): the product contains an unwanted ingredient.

To test the feasibility of the IoT food scenario just described, we develop a prototype mobile application in charge of reading the QR-code, accessing the food data, checking the consumer's preferences and suggesting to the consumer whether or not to buy the product.

The IoT food scenario and the prototype architecture are reported in Fig. 3: a QR-code is printed on the product label and a QR-code reader is in charge of accessing to what's inside the product (possibly using an external DB), of checking whether the product characteristics meet the consumer's requirements, and of telling consumer if the product meet his/her preferences.

Figure 4 shows three different screen-shots of the developed prototype application: the left one shows how consumer can create a list of un-wanted ingredients; the middle one shows the QR-code reading operation and the right one shows an example of the output application (in this case the packet of cookies contains a percentage of fat that conflicts with what consumer demands).

The IoT food scenario just designed along with the developed prototype application show that consumers my receive substantial benefits: the automatic

filtering of products decreases the time for shopping and increases the purchase of the most suitable products to consumers.

4 Conclusions

In this paper we focused on the opportunities offered by the IoT if applied to the food scenario. We first investigated, through a real-world study, the consumers' behavior while food shopping and we found that people are interested in what's written on product labels and would appreciate a tool able to automatically connect them to the food data. Then, we designed an IoT food scenario using QR-code technology and finally we showed, through the development of a mobile application, its feasibility and effectiveness. The proposed IoT food scenario produces an easy connection between food data and consumers and therefore it may lead to a healthier lifestyle.

References

1. Montangero, M., Furini, M.: Trank: ranking twitter users according to specific topics. In: Proceedings of the 12th International IEEE Consumer Communications and Networking Conference (CCNC 2015), January 2015
2. Furini, M., Tamanini, V.: Location privacy and public metadata in social media platforms: attitudes, behaviors and opinions. Multimedia Tools Appl. **74**(21), 9795–9825 (2015). Springer, US
3. Gerla, M., Maggiorini, D., Palazzi, C.E., Bujari, A.: A survey on interactive games over mobile networks. Wirel. Commun. Mob. Comput. **13**(3), 212–229 (2013)
4. Furini, M.: Users behavior in location-aware services: digital natives vs digital immigrants. Adv. Hum. Comput. Interact. **2014** (2014). Article ID 678165
5. Reitberger, W., Spreicer, W., Fitzpatrick, G.: Situated and mobile displays for reflection on shopping and nutritional choices. Pers. Ubiquit. Comput. **18**(7), 1721–1735 (2014)
6. World Health Organization: Global strategy on diet, physical activity and health. WHO (2014)
7. Vazquez-Briseno, M., Navarro-Cota, C., Nieto-Hipolito, J.I., Jimenez-Garcia, E., Sanchez-Lopez, J.D.: A proposal for using the internet of things concept to increase children's health awareness. In: International Conference on Electrical Communications and Computers, pp. 168–172, February 2012
8. Fabian, B., Günther, O.: Security challenges of the epcglobal network. Commun. ACM **52**(7), 121–125 (2009)
9. Ren, S., Huanliang, X., Li, A., Zhou, G.: Meat-productions tracking and traceability system based on internet of things with RFID and GIS. Trans. Chin. Soc. Agric. Eng. **26**(10), 229–235 (2010)
10. Kouma, J.-P., Liu, L.: Internet of food. In: International Conference on Internet of Things, pp. 713–716 (2011)
11. Jia, B., Yang, Y.: The design of food quality supervision platform based on the internet of things. In: 2011 International Conference on Transportation, Mechanical, and Electrical Engineering (TMEE), pp. 263–266, December 2011