Stefano Valtolina, Barbara Rita Barricelli (2015):
Enduser Empowerment in Lifelogging Activities.
In International Reports on Socio-Informatics (IRSI),
Proceedings of the CHI 2015 - Workshop on End User Development in the Internet of Things Era
(Vol. 12, Iss. 2, pp. 27-32)

Enduser Empowerment in Lifelogging Activities

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Abstract. With the widespread of Internet of Things' devices, sensors, and applications, the quantity of collected data grows enormously and the need of extracting, merging, analyzing, visualizing, and sharing it paves the way for new research challenges. This ongoing revolution of how personal devices are used and how they are be-coming more and more wearable has important influences on the most well established definitions of end user and end-user development. The paper presents an analysis of the most diffused applications that allow end users to aggregate quantified-self data, originated by several sensors and devices, and to use it in personalized ways. From the outcomes of the analysis, we present a new EUD paradigm and language that extends the ones existing in the current state of the art Internet of Things.

1 Introduction

The Internet of Things (IoT) concept was coined in 1999/2000 by Kevin Ashton and his team at MIT's Auto-ID Center [1] and rapidly spread around the world thanks to the evolution of sensor technology and its use that is becoming more and more mobile and pervasive [2]. To connect uniquely identified everyday objects in a network allows to send and receive data and at the same time to influence the behavior of the objects in two ways: automatic, on the basis of the collected data, and semi-automatic/manual, according to users' needs and/or preferences. Recent studies [3, 4] show that the coming of IoT changed the way people use the Internet, and mobile and sensor-based devices. This tendency is more relevant in domains that present pervasive characteristics where the integration of data could help in improving quality of life and in offering an even richer and satisfying experience of use of everyday objects. This type of integration is what characterizes the so-called lifelogging: keeping track of the collected data through all the everyday or occasional activities that may influence people's quality of life. Lifelogging, initially conceived in the 70s as a 24/7 broadcasting of self-videos, has become today a wide spreading phenomenon, called quantified-self movement, that allows people to keep track of their habits, health conditions, physiological data, and behavior, and to monitor conditions and quality of the environments in which they work and live. Today, a continuously increasing number of lifelogging devices are on the market and become more and more affordable to the masses. Some of the most advanced IoT devices offer solutions based on artificial intelligence and expert systems for avoiding to prompt users too often and risking to bother them with too many questions. The idea to make objects and environments able to take decisions on behalf of the users aims at not disturbing and overwhelming people in their everyday lives. Although these automatic suggestions avoid to bother users by helping them in managing objects more easily, we believe that the user control over connected objects is a crucial element for IoT success. According to this consideration, IoT allows the end users to manage physical devices, interactive systems, and quantified-self data by deciding how to create new usage scenarios and this empowers them more than ever, making them evolve from passive end users to active end-user developers [5]. Although, the definitions of EUD given in [5,6,7] still sound valid to describe the end user as someone interested in using digital devices just for the sake of it and not with the idea of becoming expert in the technology, these definitions do not reflect anymore the current scenario of IoT due the missing of considerations about time, space, and social dimensions. The broadening of the space dimension in the use of digital devices leads to a revision of all those definitions of end users that consider the context of use as fundamental. Another problem with these definitions is that the notion of time in today's life and the way in which we manage it have deeply changed. The growing computational performance of the digital devices leads towards a growing speed in user's performing actions and take decisions. Moreover, when dealing with sensors and temporal data, there is the need to make a distinction between valid time and transaction time. The first refers to the instant in which an event actually occurs, while the second is linked to the instant in which the event has been registered in the system. Another aspect that changed in the last decade is the concept we have of the social dimension in which we live: the digital devices have become not only tools to satisfy the need of getting jobs done but also the key for taking care of social relationships (real or virtual). According to this need to shift the EUD definition towards more time, space and social-centric aspects, in the next sections we present the definition of a new EUD paradigm and language in IoT domain. Specifically, we propose a sensor-based rule language able to support the end user in aggregating and combining data originated by several sensors/devices and in creating personalized use of the quantified self-data. This language aims at enabling end user for unwittingly developing personalized IoT environments according to specific temporal and spatial conditions that may affect the elements in the IoT environment.

2 A New EUD Paradigm and Language for IoT

The most diffused applications for IoT that exploit EUD principles allow users to define sets of desired behaviors in response to specific events rules definition-wizards that rely on the states of sensors/devices. Such strategy is adopted by those applications that use automated rules-based engines like Atooma (http://www.atooma.com/) and IFTTT (https://ifttt.com) – by using the programming statement IF this DO that, and by Wewiredweb (https://wewiredweb.com/) with the statement WHEN trigger THEN action. Instead, other applications stems from the outstanding work done with Yahoo's Pipes (https://pipes.yahoo.com/pipes/) and they typically use EUD strategies as formula languages and/or visual programming. Applications like Bipio (https://bip.io/) and DERI pipes (http://pipes.deri.org/) offer engine and graphical environment for data transformation and mashup. They are based on the idea of providing a visual pipeline generator for letting the end user creating aggregation, filtering, and porting of data originated by sources. An advanced use of such visual paradigm is offered by WebHooks (https://developer.github.com/webhooks/) that allows the end users to even write their personal API for enabling connections with new sources of data. Both presented typologies of EUD strategies, adoptable in the context of the IoT applications, offer a solution able to gather information from across the net and trigger specific actions when certain things happen. The adoption of the IF-THIS-DO-THAT/WHEN-TRIGGER-THEN-ACTION patterns are not enough to deal with more sophisticated rules based on time and space conditions. On the other hand, the second type of applications offers a too complex solution for supporting the end user in expressing their preferences. Pretending that the end users are able to deal with APIs of several sensors/devices put at risk the success of the EUD approach. Another problem with the current state of the art regards the fact that in the most diffused applications the social dimension is commonly taken care of, while time and space dimensions are almost never considered. To face these problems, we propose an extension of the IF-THIS-THEN-THAT paradigm by presenting a sensor-based rule language able to support the end user in defining rules in a more articulated way but keeping the complexity at an acceptable and accessible level. The idea is to define a paradigm able to allow end users to design triggers that depend also on time and space and not only on social media content, like most of the applications in the current state of the art. The introduction of time dimension allows end users to set triggers that can be fired at some specific time, delayed in case of certain conditions are verified, and may be repeated until some event happens. The space dimension gives end users the chance of linking triggers to the place/area where they currently are, where they will possibly be in the future, where they are moving into, or where some events are taking place. The EUD paradigm we propose aims at supporting the end user in composing space/time-based rules for extending the well-established but not powerful IF-THIS-THEN-THAT paradigm. Our Sensor-based Rule Language follows syntax, semantics, and grammar of a Policy Rule Language proposed in [8], and is based on the ECA (Event, Condition, Action) paradigm [9]. Our language allows to specify rules stating policies for triggering actions (one or a set). The general format of a rule is the following (square brackets denote optional components):

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RuleName: “MY RULE”
ON Sensor[s]
    [WHENEVER “Condition”]
Action: “Some Actions”
    [VALIDITY: Validity_Place-Interval]
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A rule consists of several components. The RuleNamecomponent represents the rule identifier. Users can retrieve rules by means of such identifier for visualizing, sharing, dropping, or modifying them. Sensor[s]represents the sensor or set of sensors upon which data the rule is triggered. Each sensor exposes a set of parameters which can be used for expressing the conditions. Condition is an optional conditional expression. Action is an expression that states what happens when the condition is verified. Validity_Place-Intervalis a special spatial and/or temporal condition also expressed by means of the condition language we developed, representing the space and time period during which the rule is enabled. In this statement, the keyword IN is used for specifying rules that need to be triggered if the data streams refer to a specific geographical place/area. The keyword AT is used to indicate a rule that is triggered at a well-defined time, while the keyword EVERY could be combined with an expression of type PERIOD for repeating execution of a particular action regularly after a fixed period of time has passed. For example, if the interval [EVERYDAY EXCEPT SATURDAY] is specified we know that a rule is enabled every day of the week but not on Saturday. But if Validity_Place-Interval is not specified, we know that the rule is always enabled. By means of Validity_Place-Interval it is possible to state that certain rules are not always enabled; rather, they are enabled only if an event happens in a specific place or during specific temporal intervals. Such a feature is not provided by conventional apps for IoT.

3 Conclusion

In this paper, from a study of the most diffused applications for IoT that offer EUD tools, we identified and discuss some open problems and proposed a new EUD paradigm and language to solve them. Further developments of this research will consist in the design and development of an interactive visual system aimed at implementing the paradigm and language proposed and at testing its validity.

4 References

[1] Ashton, K.: That 'Internet of Things' Thing. RFID Journal, June (2009).

[2] Atzori, L., Iera, A., Morabito, G.: The internet of things: A survey. Comput. Netw. 54(15), 2787--2805 (2010).

[3] Meder, J.:Human Empowerment in a Semantic Web of Things: Concept of a semantic platform for connected devices. Master Thesis at Uppsala University, Department of Information Technology (2014).

[4] Munjin, D.: User Empowerment in the Internet of Things. PhD dissertation at University of Geneve, Department of Economy and Management. (2013).

[5] Lieberman, H., Paternò, F., Klann, M., Wulf, V.: End-User Development: An Emerging Paradigm. In: H. Lieberman, F. Paternò, & V. Wulf (Eds.) End-User Development, pp. 1--8). Springer (2006).

[6] Costabile, M. F., Fogli, D., Mussio, P., Piccinno, A.: Visual Interactive Systems for End-User Development: a Model-based Design Methodology. IEEE TSMCA, 37(6), pp. 1029--1046 (2007).

[7] Petre, M., Blackwell, A. F.: Children as Unwitting End-User Programmers. In: Proc. of VL/HCC 2007, pp. 239--242 (2007).

[8] Widom, J., Ceri, S.: Active Database Systems. Morgan Kaufmann Publisher (1996).

[9] Bertino, E., Cochinwala, M., Mesiti, M.: UCS-Router: A Policy Engine for Enforcing Message Routing Rules in a Universal Communication System. In: Proc. of Mobile Data Management 2002, pp. 8--16 (2002).