When Artificial Intelligence Alone is not Enough: End-User Creation and Control of Daily Automations

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The combination of the Internet of Things and Artificial Intelligence has made it possible to introduce numerous automations in our daily environments. Many new interesting possibilities and opportunities have been enabled, but there are also risks and problems. Often these problems are originated from approaches that have not been able to consider the users' viewpoint sufficiently. We need to empower people in order to actually understand the automations in their surroundings environments, modify them, and create new ones, even if they have no programming knowledge. The course discusses these problems and some possible solutions to provide people with the possibility to control and create their daily automations.

CCS CONCEPTS • Human-centered computing~Human computer interaction (HCI)~Interactive systems and tools~User interface programming •Human-centered computing~Ubiquitous and mobile computing~Ubiquitous and mobile computing systems and tools

Additional Keywords and Phrases: End-user development, everyday automation, Internet of Things

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1 BENEFITS

The main technological trends of recent years have been the Internet of Things and Artificial Intelligence. Their combination has made it possible to introduce numerous automations that can manifest themselves in different ways in our daily environments. Many new possibilities and opportunities have been created, but also risks and problems. Often these problems are originated from approaches that have not been able to consider the human point of view sufficiently. In particular, the user has often been considered as a passive element with respect to the new possibilities instead of being the central subject. People in their lives often have dynamic needs, which sometimes are originated from episodes, even unpredictable ones. The most effective automations are often the ones that can be dynamically customized and created to meet these changing and different needs that only the users know completely. Thus, we need to empower people in order to actually

understand the automations active in their surrounding environments, modify them, and create new ones, even if they have no particular programming knowledge.

For such reasons it is of paramount importance that designers and developers be aware of such issues and of some possible solutions to provide people with the ability to control and create their daily automations. Thus, this course aims to allow attendees to gain knowledge and skills in addressing problems and solutions involved in end-user creation, control, monitoring, debugging automations that can be deployed in their daily environments (home, office, shops, …). It will provide a discussion of the possible solutions in terms of concepts, techniques, and tools, with particular attention to those supporting the trigger-action paradigm. The course will discuss how to enable people who are not professional developers to indicate the various dynamic events and conditions that can occur in their contexts of use (considering aspects related to user, technology, environment), and the possible associated actions.

2 INTENDED AUDIENCE

The course is interesting for designers, developers, and researchers who want to understand the issues involved in introducing automations in daily environments, and the corresponding possible solutions that can empower end users in controlling, modifying and creating new ones. It also allows them to understand the relevant state of art in order to think about novel solutions in this area.

3 PREREQUISITES

There is no particular prerequisite for attending the course. Some basic knowledge of Internet of Things technologies would make it easier to follow it, but all the relevant concepts will be introduced in such a way to be understandable also to those who are not familiar with them.

4 CONTENT

The tutorial will start with an introduction to the main current technological trends (internet of things and artificial intelligence), followed by a discussion of their problems when end user viewpoint is not considered (see for example the study reported in [9]), such as the learning system fails to understand user intent or the system's behaviour is hard to understand. At this point there will be a brief introduction to end-user development, its importance to empower people to customize their applications, the main approaches that have been considered, and the aspects that have to be addressed in order to provide effective solutions.

Next, I will first introduce the trigger-action programming paradigm [1, 2, 4, 5, 8], which is suitable for end-user development because of its compact and intuitive structure, which connects the dynamic events and/or conditions with the expected reactions without requiring the use of complex programming structures or particular algorithmic abilities. This approach has been used in several domains, such as home [8], ambient assisted living [4], robots, [6], finance [3]. Thus, I will discuss what an event, a condition, and the possible consequent actions can be. In this discussion I will also introduce the aspects that sometimes are unclear for end users [1, 5] when they have to approach automations in internet of things scenarios.

At this point the participants will be asked to actually write three examples of automations in natural language in pairs, with different complexity (one trigger and one action, two triggers and one actions, two triggers and two actions). During this exercise we will discuss together the rules created and how well they specify the desired

behaviour in order to allow participants to better understand possible ambiguities and problems in their execution.

Next, the discussion will move on to introducing examples of visual environments (Node RED, IFTTT, …) that aim to support this type of approach, and discuss them in terms of their usability and expressiveness. For example, IFTTT only supports rules with single trigger and single action, and does not explicitly distinguish between events and conditions, and this sometimes can be limiting [8].

I will then discuss possible approaches for supporting visual composition of the automation rules based on different interaction paradigms (wizard, block composition, data flow), and then show how personalization platforms (such as TAREME [4]), can support the dynamic execution and monitoring of the created rules. I will report on example of deployments of this type of platform in the wild (student home, ambient assisted living project) in order to discuss the possible issues and advantages in deploying this approach in real cases studies. For example, I will discuss real experiences with this approach to personalization in the PETAL European project, which aims to support remote older adults assistance through personalisation rules specified by caregivers or the older adults themselves. Another experience was carried out with a students' home, which was equipped with a number of sensors and appliances in order to investigate the use of the personalisation platform in the wild. Results and issues in such experiences can provide useful insights to understand how to deploy and use tools for personalising automations in general.

Then, participants will be asked to specify four automations in the form event / condition / action for context-dependent user interfaces, with at least two rules including at least two triggers, and each rule should refer to different contextual aspects, by using two different visual tools publicly available on the Web (e.g. IFTTT and TAREME). In this way they can take direct experience on this type of tools and discuss possible advantages and disadvantages.

I will then discuss possible methods to help people who are not professional developers to check that the personalization rules created do not have conflicts and actually support the desired behaviour [2].

The next part will be dedicated to showing how trigger-action rules can be used to personalize the behaviour of a humanoid robot. For this purpose, their applications to a Pepper humanoid robot will be demonstrated with examples and videos. The robot can be considered a natural extension of the Internet of Things since it is composed of a number of sensors and appliances. In addition, it will be discussed the possibility to connect events derived from external sensors with those detected by the robot, which then can have effects on surrounding appliances and the robot behaviour as well.

The next part will be dedicated to discussing possible approaches able to provide serendipitous support in creating, monitoring, and modifying automations in daily environments. The role of augmented reality techniques in this perspective will be addressed as well.

The last part of the tutorial will be dedicated to discussing with the audience the various concepts and tools presented, and also to analyse together whether other design aspects should be considered. We will conclude with a short discussion of a research agenda for this area. The next table shows the tutorial schedule.

Table 1: Tutorial schedule

Subject	Duration
Introduction Course	5’
The technological trends (IoT + AI)	5’
The dark side of intelligent automations	5’
Trigger-action programming	10’
Automation definition exercise	10’
Visual environments for end user creation of automations	10’
Exercise with tool for end user automation creation	10’
Explainable end user automation debugging	5’
Automations involving robot behaviour	5’
Support for serendipitous end-user automation creation	5’
Final Discussion	5’

5 PRACTICAL WORK

There will be two interactive exercises, and a final discussion session. In the first exercise participants in pairs will write three examples of automations in natural language, with different complexity (one trigger and one action, two triggers and one action, two triggers and two actions). During this exercise we will discuss together the rules specified and how well they specify the desired behaviour in order to allow participants to better understand possible ambiguities and problems in their execution.

Then, participants will be asked to specify four automations in the form event / condition / action, with at least two rules including at least two triggers, and each rule should refer to different contextual aspects, by using two different visual tools publicly available on the Web (e.g. IFTTT and TAREME). In this way they can take direct experience on this type of tools and discuss possible advantages and disadvantages.

The final discussion will aim to summarise the main relevant concepts and receive feedback from the participants on to what extent they are able to apply them in designing automations for the contexts that are interesting for them.

6 INSTRUCTOR BACKGROUND

Fabio Paternò is Research Director at CNR-ISTI, where he founded and leads a laboratory on Human Interfaces in Information Systems. He was co-editor of the book on End User Development (1000+ citations on Google scholar), and the follow-up on New Perspectives in End User Development. He was one of the co-editors of a TOCHI special issue on End User Development for the Internet of Things. He is an ACM Distinguished Scientist and an ACM Distinguished Speaker. He has already given courses or tutorials at CHI, INTERACT, Mobile HCI; HCI International. He is the scientific coordinator of the AAL PETAL project

(http://www.aal-petal.eu/) and the PRIN EMPATHY (http://www.empathy-project.eu/) project where the issues and solutions discussed in the course have been investigated.

7 RESOURCES

I will create a Web site for announcing the course, and its content and format. The Web site will provide relevant resources as well. I will advertise it through various relevant mailing lists and social channels.

ACKNOWLEDGMENTS

Part of the content of this course has been derived from work carried out in the AAL PETAL project (http://www.aal-petal.eu/, and in the PRIN EMPATHY (http://www.empathy-project.eu/) project that I coordinate.

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