Artificial Intelligence versus End-User Development: A Panel on What Are the Tradeoffs in Daily Automations?

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Abstract. Artificial Intelligence (AI) and End-User Development (EUD) look at automation from two different perspectives. The former tends to provide fully automatic solutions, the latter aims to empower users to directly create what they want. We need both, but it is still unclear how to combine them to obtain effective every-day automations that meet the flexible and dynamic user needs. The panel aims to stimulate the Human-Computer Interaction community to think more carefully about such aspects and the possible approaches to address them.

Keywords: Artificial intelligence · End-user development · Automations

1 Motivations

Automation is finding its way into many parts of everyday life. This is manifested by the increasing opportunities for end users to offload decisions to their home appliances, to hand over control to their cars, or to go shopping at self-checkout stores. Supported by Artificial Intelligence (AI), emerging automated services integrating analysis and decisions based on the processing of large information sets are becoming widespread. In anticipation of the broad impact that these emerging technologies will have on our life, a reflective and systematic consideration is necessary that leverages their full potential in terms of user experience.

While there is a long human factors research tradition on automation, such research has long been concentrated on highly specialized professional work tasks for highly trained and specialized personnel, such as control centre operators or pilots. However, the analysis of technological trends indicates that more than 30 billion devices currently make up the Internet of Things (IoT) demonstrating its pervasiveness. With such technological innovations and new use cases in domains such as industry, home automation

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and retail, the goal of designing automation for a broader population has become crucial. This transition of automation technology towards everyday life has thus brought people's experience to the centre of attention, thereby making it the mediator between humans and the surrounding technologies [5].

In everyday automation usage situations, continuous interaction is typically not as central as with manually operated systems. The relationships of users to automation in everyday contexts can be described as forms of "implicit interaction" [9] or "peripheral interaction" [3]. However, while implicit and peripheral interaction is often thought to imply that users provide inputs to a system, automated systems can often go further by taking the initiative in addressing user needs. The associated challenges include how to make users understand "when it is their turn", when they can override, and where it is best that they follow the recommendation of a system. Supported by these new forms of implicit interaction, many automated systems no longer feature prominent displays, and they are merging into the users' surroundings. In a sense, everyday automation is thus a strong driver for putting into practice the visions of "ubiquitous computing", "disappearing computer", as well as "ambient intelligence". The ambient nature of automated systems and their interwovenness in mundane, repetitive routines also supports the ordinariness of the involved user experience [4].

There is an increasing number of automations that are activated through the use of AI techniques, but they sometimes provide undesired effects and people have difficulties in understanding why they are generated, and how they can be modified and controlled [8]. AI systems in the user's surroundings can be enabled to learn and consequently change their behaviour. While the adaptation to user preferences can increase ease-of-use, this may have an impact on their intelligibility. Issues to be addressed include thresholds for perceivability and acceptance factors of system adaptation over longer time periods, and the possibility of modifying adaptations when they are not effective. In many usage contexts, manual interventions have to be supported, in order to better adapt the system behaviour to the respective context and preferences [10].

Such interventions require the user to switch from a passive mode towards an active one in both using the system and understanding the domain in which the system is operating. Related challenges regard designing environments able to allow users to understand what interventions they can perform, and which associated effects their actions will entail. Apart from situation-dependent interventions, people can also take on quite an active role when it comes to the customization of automated systems. In fact, automation offers the potential for the creative planning and customization of system behaviours even to people who have never programmed before. Many services, such as IFTTT ("If-This-Then-That"), offer means for the configuration of routines but they have limited capabilities, and thus often are inadequate to express user needs. A central question in this regard is how to enable people with no or little programming skills to customize the automation behaviour.

End-User Development (EUD) [1] represents the objective to empower all stakeholders (designers, users, workers, learners, teachers) to actively participate and make their voices heard in personally meaningful problems. EUD methods and techniques should allow users to understand what they can customize and whether what they specify actually corresponds to the desired behaviour. In both cases, it is crucial to adopt meaningful metaphors and related interactive paradigms [2]. The resulting solutions should be available for immediate and easy use, for example by allowing users to specify their desired personalisation rules through direct interactions with the objects involved in the automation (which is a form of Programming by Demonstration (PBD)). Here, the AI might help the users generalize the demonstration to create reusable automations [7]. However, when non-programmers are supported, some mechanisms are needed to safeguard the correct functioning of the system. Additionally, there is the need to address the challenge of both enabling informal EUD languages while still maintaining formality on the system's side. One further challenge is to allow end users to understand the actual effects consequent to the automations that they create or modify. While most approaches in explainable AI (see for example [6]) focus on providing indications on the outcome of some machine learning algorithms, in this panel we aim to discuss ways to allow people to both understand and control the algorithms, the dynamic effects that the resulting automations might have and their interference with other existing ones.

Enabling end-users to control automation [11] thus raises important research questions in terms of adequate modelling abstractions that can lead to incorporating the notion of explainability, configurability, user control from the beginning of the design process, rather than to add these dimensions when the systems are already in place. New design approaches, based on a human-centered perspective and intrinsically accounting for user intervention and control, are needed to let the end users make sense of automation capabilities.

2 Discussion

Given the background described in the previous section, several points can be discussed in the panel, for example:

- What are the dark patterns of AI and those of EUD, examples of cases where such disciplines provide effects that conflict with users' ability to actually obtain and control the desired daily automations?
- What are the application domains and associated scenarios where everyday automations actually controlled by end users can have high impact (possible candidates: smart homes, ambient assisted living, retail, industry 4.0, …)?
- What are the most suitable technologies, metaphors, interactive paradigms, programming styles to allow people to easily control, create, modify the automations most relevant for them in their daily activities (e.g., wizards, chatbots, block-based, data flow, process-oriented, PBD)?
- What are the principles, design practices, and methodologies available in Human-Computer Interaction (HCI) that could be adopted to empower the end-users to control automation in AI systems?
- What can the role of recommendation systems be in smart environments that users can control? When, how, and for what purpose can recommendations be useful and usable?
- What are the most effective ways to explain the automations that populate surrounding environments as well as their actual effects to users with limited technological knowledge?

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