
Everyday Automation Experience: Non-Expert Users Encountering Ubiquitous Automated Systems

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ABSTRACT

Automated systems and their interfaces are increasingly merging with our ambient environment leading to a heightened impact on our everyday leisure and work experiences. While automation systems have been a realm for highly specialized tasks and trained experts until recently, now more and more non-expert users encounter automated systems in their everyday life. The deployment of these systems fundamentally changes practices and experiences in various domains. The overall goal of this workshop is to investigate the requirements and design criteria for automation that are experienced in everyday situations. In particular we will strive to come up with a set of principles for three key areas of everyday automation experience: intelligibility, experienced control, and capturing automation experience. This way, the workshop provides a first forum for knowledge exchange and networking across usage domains and contexts.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI); Interaction paradigms; Empirical studies in HCI.**

KEYWORDS

Automation; User Experience; Automation Experience; Human Intervention; Automation Intelligibility

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BACKGROUND

Automation is starting to accompany us in many forms of everyday life and is thus leading to changing practices in various domains and applications areas. House owners orchestrate their appliances in their 'smart homes', drivers negotiate control with their cars, public transport passengers are starting to use autonomous buses, shoppers do not deal with human sales attendants any more, and workers in factories see themselves in the role of monitoring rather than actively controlling. This emergent role of automation in our environment has an impact on the way how people can be supported in perceiving, monitoring and configuring technologies in a variety of situations [21].

There is a highly influential tradition of research in 'Human-Automation Interaction' (HAI), with roots in the 1950s and early '60s (e.g., [7]), that increased our understanding of how humans are affected by, control and receive information from automation [5, 23, 24]. Despite this legacy, recent

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advances of industry and human factors research in developing automated control for highly trained users in avionics (e.g., [17]) or process control rooms [9] have left us with major knowledge gaps for massive-scale adoption of higher automation levels by non-experts (not specifically trained to use a system), be it in the home [3], automotive transportation [13], or the shop floor [20, 27]. Research in HCI that explicitly addresses the relation of experience and automation is rare (e.g., [8, 18]). Apart from the currently growing body of knowledge on autonomous driving [13], there is some user experience research in the engineering domain that touches on issues of automation [14, 25], as well as some field research exploring everyday experiences with automation in a factory context [19]. There is also some research on experience and automation from a design perspective [12].

This workshop aims to provide the first forum for the investigation of ubiquitous automation technologies as they are experienced in everyday situations by non-proficient users. We thereby strive to engage with cross-domain, user-centered design challenges and principles of everyday automation experience. While in principle the workshop is open to all levels of automation up to full autonomy, our focus is on the notion of so-called 'intervention user interfaces' [22]. These "allow for unobtrusive awareness of automated processes with routinized tasks, suggest options for intervention and provide elements that allow the user to change the behavior of the currently running processes with immediate effect." In the following sections, we describe three central challenges related to our notion of automation experience that we will elaborate upon: intelligibility, experienced control, and capturing experience.

INTELLIGIBILITY

Sensors and networked digital elements embedded in our homes, cars and public surroundings support us in our everyday life, but they can also be confusing when they do not work as expected. For example, if the window blinds go up and down at unusual times in an automated building, typically residents can only speculate about the underlying rules. This problem of the limited intelligibility of the rationale(s) behind automated processes has been a topic of research for many years (compare an overview of research on intelligibility and explainability in [1]). However, most of that research has been targeted to computing experts and data analysts rather than everyday users. Also, end-user development systems provide features that make them more understandable for non-programming experts [16], and they have been tested in everyday contexts such as smart homes [4]. However, these tests have been devised primarily for creating novel rules, not to inform pure passive use. While specific intelligibility approaches have been put forward for non-experts with ubiquitous systems [26], these have not explicitly focused on specific issues of automation.

Another currently evolving aspect is 'awareness and intent communication', such as when automated cars tell pedestrians or passengers about their state of knowledge and planned activities [15]. To date, there have been few attempts to gain a common, cross-domain understanding of suitable

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awareness and intent communication principles. The closest approach and most notable exception has been the research stream on communicating uncertainty [6]. Potential respective research questions and challenges to be addressed are as follows:

- How and when to communicate the state of a ubiquitous automated system to non-experts (considering the requirements of a specific application domain)?
- How to provide non-expert users with an overall understanding of the reasoning of a system?
- How to communicate human intervention opportunities and potential consequences?
- How to design for cross-domain intelligibility of ubiquitous automated systems?
- How to allow people without programming skills to personalize the behavior of a system?

EXPERIENCED CONTROL

There is a close relationship between automation and control. Schmidt and Herrmann [22] claim that “the notion of control is central to interaction with automated and autonomous systems.” Problems regarding control can be considered as inherent to automation as aims to reduce (explicit) user interactions [10]. For example, explicit input modalities like buttons are often replaced by sensors that automatically recognize users’ intentions. Additionally, unobservable software processes that connect different machines make it increasingly difficult for people to understand the system processes. Thus, experienced control is an essential problem when interacting with ubiquitous automated systems. For people encountering automated systems, all these issues are experienced as the reduced possibility of intervention with a system and even a total loss of control (this is especially relevant when systems errors or breakdowns occur). To provide positive and meaningful experiences with automated systems, we need to better understand and dig deeper into the issue of (experienced) control. For example, HCI researchers and designers should study how people experience control in relation to automated systems in different domains and investigate current practices of use related to control (e.g., maintaining or regaining control over the system). The workshop will address the following topics and questions in relation to experienced control:

- How to efficiently provide non-expert users with required knowledge and feedback to deal with an automated system in an exceptional state?
- How to allow human interventions in complex automated procedures?
- How to design for negotiating control between user and system (how much control should the user have)?
- How to design for an efficient and enjoyable interplay of non-expert users and automated systems?

CAPTURING AUTOMATION EXPERIENCE

The rise of 'peripheral interaction' with ubiquitous systems [2] or the notion of 'implicit interaction' [11] also highlights the shifting nature of our everyday interactions with autonomous systems (as already mentioned in the previous section). Regarding user experience with automated systems, the question arises, what does it mean to experience ubiquitous automated systems if they are increasingly encountered indirectly or on the periphery of users' attention? Additionally, how do we study these indirect interactions? New or adapted user experience methods are needed to adequately capture and access everyday automation experience. It is of specific importance to reflect on how automation experience can be theoretically framed and empirically captured. Currently, there is only limited conceptual work that explores the facets and characteristics of user experience related to the indirect encountering of automated systems [19].

Corresponding research questions and challenges related to this topic include:

- How to adequately capture and theoretically frame experiences with ubiquitous automated systems that are encountered unobtrusively?
- Which methods and approaches are specifically beneficial for capturing users' everyday automation experiences?
- What commonalities and differences exist when studying automation experiences in different application domains (e.g., influences of contextual characteristics)?
- How to capture and characterize experience with completely autonomous systems without any user interface (e.g., heating management systems)?

WORKSHOP GOALS

This workshop investigates the requirements and design criteria for automation that are experienced by non-experts in everyday situations. In line with this overall goal, it will pursue the following subgoals:

- Provide an overview of the diverse field of automation experience and introduce recent research.
- Reflect on major challenges of interacting with and experiencing ubiquitous (semi-)automated systems and discuss ways to address them.
- Exchange ideas and networking across domains to enable knowledge transfer and best practice exchange regarding the recognition of universal design strategies for ubiquitous automated systems.
- Identify promising future work in the field of user experience of ubiquitous automated systems in the form of a research agenda.

Preliminary Schedule

09:00 – 09:15 (15 min.)
Opening & Introduction

09:15 – 10:30 (75 min.)
Participants' Presentations I

10:30 – 11:00 (30 min.)
Coffee Break

11:00 – 12:15 (75 min.)
Participants' Presentations II

12:15 – 12:30 (15 min.)
Wrap-Up of Emerging Topics

12:30 – 14:00 (90 min.)
Lunch Break

14:00 – 14:15 (15 min.)
Presentation of Challenges

14:15 – 15:45 (90 min.)
Creative Thinking

15:45 – 16:15 (30 min.)
Coffee Break

16:15 – 16:45 (30 min.)
Presentation of Solutions

16:45 – 17:30 (45 min.)
Agenda Definition & Wrap-Up

WORKSHOP STRUCTURE AND ACTIVITIES

The workshop is a one-day event. The sidebar on page 6 shows the preliminary workshop schedule.

Following the workshop opening by the organizers, the morning session will feature participant introductions and presentations of position statements over two time slots. In advance, the organizers will thematically group and order the presentations according to the central challenges presented in this proposal (intelligibility, experienced control, capturing experience) and according to any emergent topics from the submissions. Participants will be asked limit presentations to six to eight minutes (depending on the number of participants) to create a dynamic and inspiring workshop atmosphere. To connect participants and encourage communication in preparation for the creative team work in the afternoon, each thematic session will close with a short round of feedback and discussion. These discussion rounds and the dedicated wrap-up session before lunch will allow us to surface salient, new topics and form initial groups for the afternoon session.

The organizers will start the afternoon session by briefly introducing the core challenges of interacting with ubiquitous automated systems (see the respective sections above). Based on the discussions, initial topic identifications, and emergent groups from the morning session, as well as the organizers' input, the participants will select one challenge (probably related to their submitted position statement) to work on in teams for the remainder of the workshop. Depending on the final number of participants, one challenge can be addressed by several teams. We allocate a 90-minute "Creative Thinking" session for teams to work on promising approaches for the chosen challenge. Participants will be provided with material for the illustration of their ideas (e.g., sketching papers, post-its, card boards, a camera, Lego). They can decide whether they want to prepare a poster, video or 'Wizard-of-Oz' prototype, or use storytelling or role-playing. After the coffee break, participants will gather to share their solution approaches with the full workshop audience. Finally, the workshop organizers and participants will consolidate results and ideas into the production of a structured map of topics to be addressed in future research. As far as possible, we will identify required complementary research communities, time frames, and funding programs and project types during this activity. Plans for a dedicated programmatic publication will also be drawn up at this time.

POST-WORKSHOP PLANS

We will summarize the workshop outcomes and insights and share this summary on the project website <http://everyday-automation.tech-experience.at>. Furthermore, we will contact potential venues for a special journal issue or a magazine article on the workshop contributions and outcomes to further raise the interest in this important research area.

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