Everyday Automation Lab: Critical Discussion On Human Factors Students Research Projects

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Abstract

Designing interactions with automation requires the next generation of designers to be prepared for tackling complex socio-technical challenges, combining the psychology of human behaviour and cognition and the technical issues of non-linear, distributed, and intelligent automation. The Everyday Automation Lab experience represents an example of Human Factors students' research laboratory where to experiment the scientific method and to apply user research and ethnography in investigating human-centered automation. Students' groups investigation allowed to map the current trends, to highlight on design challenges and research opportunities and is likely to be refined in future iterations of the laboratory. Moreover the Lab allowed to define a model-based taxonomy, including *analyze*, *manage* and *act* everyday automation scenarios.

Keywords

Automation, Human Factors, Education, Research, Taxonomy.

1. Introduction

Designing interactions with automation is increasingly addressing a broader population, thanks to the widespread use of artificial intelligence in everyday scenarios and the experience of naïve users being brought into the center of attention [1].

Designers' education must thus move from a solely technology-centered approach to the adoption of an approach that considers the joint human–automation system cooperation scenarios [2]. Especially with the rise of artificial intelligence in consumer digital technology the impact, transformation and consequences of human-automation interactions come at the core of the modern Human Factors discipline [3].

Studying Human Factors today might be tightly connected with the evolution of specific aspects of user experience with relation to the design of everyday automation systems.

The opportunity of teaching a Human Factors class in an Interaction Design Master Degree Course allowed the authors to tackle the challenges of human-automation interaction and to address the different forms of human engagement with automated technology through the established Everyday Automation Lab, a research laboratory launched into the 2022 Human Factors class at the University of the Republic of San Marino. This class involved 24 Master Degree students in 5 working groups assisted by 2 professors for the duration of one semester. During this experience, by investigating everyday human-centred automation both professors and students had the opportunity to disentangle novel perspectives over human factors and to reflect upon emerging challenges.

2. Everyday Automation Lab

The Everyday Automation Lab has been launched following an integrated Human-centred automation, Human-machine interaction (HMI), Cognition and ergonomics, and Interaction design approach finalized to the design of complex human- technology-environment assemblages' interactions.

Overall scopes of the Lab are to (1) teach scientific research methodology to support designing automation that works well with

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people, (2) investigate the automotive human factors in actual everyday scenarios.

The Everyday Automation Lab aimed at supporting automation human factors research projects that take the human into account, particularly for systems in which:

- Control authority is shared between the human and the automation,
- Reasons and motivation for engaging with automation are crucial,
- Challenges, opportunities and impacts of automation are still to be explored.

2.1.Methodology

The Everyday Automation Lab had a structured and integrated human factors and design education approach aiming at providing conceptual, methodological and critical means to the students for tackling complex socio-technical challenges.

Two main modules supported the Lab: the human factors fundamentals and the human factors applications. Both had learning contents and activities bringing automation as a trigger to focus on humans. First part of the course was an introduction to Ergonomics and Design for Automation and to Socio-technical systems. These lessons were the starting point to give conceptual tools to address major challenges of automation engagement.

The second part of the course was more precisely coupled with the Lab methodology since two lessons dealt with research for design to

- Build a knowledge base to evaluate the potential impact of a product,
- Support design ideas and concept generation,
- Define spaces of opportunity for design.

In particular the students have been taught the value and importance of researching an issue starting from the definition of a theme and the choice of a phenomenon; the formulation of initial hypothesis to explain the phenomenon; the on field data collection; the analysis and interpretation of the collected data and the formulation of theories, i.e. explanations based on scientific research. Theories are fundamental for design students to find approaches, criteria, and principles for automation interaction design.

The very first activity of the Lab was the Assumption Mapping Workshop, an activity adapted by the AIGA Assumption Mapping method published by the educator Eric Forman for School of Visual Arts in 2019 [4]. At the beginning of the research, the students made many assumptions about their area of exploration. This exercise created a map to identify and categorize assumptions, and then select those most critical to test early.

Next activity has been the research scoping: what was the main question to be answered with research data? What is the phenomenon that students are going to study, what is the problem statement, what are the research objectives and what did they want to learn.

Starting from these activities the students were divided into 5 groups and a Lab Visual Collaboration board was established by using Mural, the web visual collaboration tool used to highlight:

- Objectives,
- Problem statement,
- Research questions,
- Researchers' hidden assumptions to be disclosed,
- Hypothesis and naive explanation to the event,
- Specific research plan and process,
- Target users to be engaged,
- Research time schedule, in the period October 2022 - January 2023,
- Specific method description with materials (e.g. semi-structured interviews questions),
- Results and data interpretation,
- Lessons learned.

Figure 1 reports the Mural board overview.

Figure 1: Research online board for visual collaboration.

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2.2.Themes

As extensively reported in literature [5, 6], Human Factors automotion has been studied since before World War I, with the automation mechanisms during the early stage of automobiles (1886–1919). But human factors automation cannot refer to homogenous technology: there are many types of automation and each one poses different design challenges.

The students' groups investigated the following themes:

1. Software developers mental models and automation models,
2. Trust in automated services and the role of malfunction,
3. Impact of automation on cognitive function development,
4. Artificial Human and intelligent agents in social intimacy
5. Visibility and understandability of automation

In order to investigate these themes the five groups autonomously proposed specific field application domains. Such scenarios allowed the students to concretely investigate the role of human factors and the quality of the interaction with automation. The research scenarios are introduced in the table below and described as follows.

Table 1
Lab Students' Group

Group	Research theme	Domain
1	Models	Vocal assistants
2	Trust	Banking
3	Cognition	Education
4	Sociability	Artificial human
5	Visibility	Automation

Each group went into the exploration of themes in scientific literature, starting from general perspectives on automation human factors [3] and going to specific domains investigation, like for example Group 5 automated driving functions in everyday lives [7, 8] in automotive, or Group 4 artificial human interactions, combining agency and automation [9].

2.3.Activities

Students' groups had then the opportunity to propose, discuss and review their research plans in participatory and iterative sessions involving the professors. They were supported in maintaining a coherent connection between research scope and hypothesis, between hypothesis and research methods definition, and between research activities and data collection. Being their first research project, students needed to clearly state their questions, to set their expectations for what the lessons' learnt by the end of the research are, and to understand their role as researchers.

The 5 groups developed their plans adapting what has been proposed in the following schema:

- Case study analysis and benchmark,
- Initial thematic exploration, either by experts interviews or in-depth immersion,
- 1st cycle data collection in order to get an overview on the phenomena,
- Interaction design experiments,
- 2nd cycle data collection in order to fine-tune the investigation and be able to build a valuable knowledge base,
- research findings and insights validation.

The following paragraph describes the main findings the students reached with the Everyday Automation Lab.

2.4.Results

Lesson Learnt #1 - On Vocal Assistants intelligence

Software developers do not always convey effective and consistent automation models to the users, and their mental models and beliefs cannot be considered the same as final Vocal Assistant users. Indeed voice assistants rely on large datasets to identify macro-categories that are refined with use.

Some assistants add information, but the majority of systems are manually updated by developers: in this case, user interaction is crucial, more central than the outcome, as the assistant capabilities can be improved and refined through it.

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Voice assistants store and learn the information behind the routines: they are actually able to adapt to the users' needs and habits according to both the initial setting provided by the programmers and the number of uses: the more the assistant is used, the more it will be able to adapt and recognise the user's needs. The learning process has some limitations in sketching its user dictated by European and international regulations that protect consumer privacy.

Lesson Learnt #2 - On Errors and Trust

By reflecting on the type of relationship between ethics and automation, students found that networked digital technologies offer great opportunities for the economy and society, but raise ethical issues.

We want to investigate where trust comes from and how it develops. In particular the hypothetical error (or malfunction) of the machine does not affect the level of trust the user places in it. The automations within the payment and financing services that lead us to trust or not trust a service.

Lesson Learnt #3 - On Automation in Education

It is assumed that automation and technology in schools do not bring negative effects to students. On the contrary, it is thought that if used within the right time limit automation can increase the pleasure of learning. It is therefore advisable to limit the use of technological devices that are not inherent to learning (at least in the developmental years of primary school) in order to avoid repercussions at a behavioural and attentional level. It is necessary to prepare pupils for the future life now immersed in the world of technology and small automations that accompany us every day. A trivial but effective example is the automatic entry of passwords, no need to learn endless amounts of codes but only the one to open the 'padlock'.

Lesson Learnt #4 - On Intimate Sociability with Agents

Gender bias works in automation as well: the gender of the assistant also influenced the choice, especially when precise application scenarios were set: male voices were preferred for responsible tasks, while female voices were preferred for routine tasks or company.

This discrepancy stems from a context in which men are usually given management and responsibility roles, while women are given maintenance and care tasks.

People would not choose to use the voice of a friend or family member, because they would be afraid of spoiling their relationship with that person and because they feel it would dehumanise them. This shows on the one hand a natural tendency to give voices a body, thus humanising them, and on the other hand a dehumanisation of the person when he or she becomes an assistant in our service.

Figure 2: Contextual interview (on the left), field observation and shadowing (on the right)

Lesson Learnt #5 - On Automation Visibility in Automotive

Thinking about automotive and car automation we might say that there is a general overestimation of the technical level of one's car.

Especially with the interviews, but also with the questionnaire data, we can deduce that the most used automations are not so much those that are perceived more, understood better or, in general, more visible. Those most used are those considered most useful for the driver and his habits, and that are of public knowledge.

It is not visibility that determines the use of automation; it is the use itself through everyday life or experience and the popularity of it that determines the visibility of automations. In fact, trivially, the automations that are needed and often used are those that attract the most human attention through perceptual cues, such as visual, acoustic or textual signals.

3. Conclusion

By analyzing the automation types across the five themes, we derived a bottom-up taxonomy of roles played by automation in

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everyday life. The taxonomy is case-derived, trying to map the current trends, and is likely to be refined in future iterations of the laboratory. It is not a model-based taxonomy, with logical categories neatly differentiated one from the other. There are overlaps and "soft boundaries".

The taxonomy is structured on two dimensions: human activity supported and type of support.

As for human activity, we differentiated among three activities:

- Analyze: automation providing information to the user by capturing, processing, and analyzing data.
- Manage: automation supporting the user in managing the workflow, organizing and prioritizing tasks.
- Act: automation capable of performing actions/tasks (to face a situation or recover from errors).

The type of support may be either on-demand or proactive, differentiating automation that needs to be activated by users, or that proactively steps in when needed.

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