Exploratory Paper: An interdisciplinary perspective on designing a socio-technical assistance system that is conducive to learning

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Introduction

In this workshop, we would like to address two questions:

1. How to translate and materialize a social scientist's perspective into a robot system's design?
2. How to negotiate social sciences and engineering?

Since the end of 2020, we have partnered with a medium-sized company that develops a collaborative robot system to automate the process of wiring an assembly panel in switch cabinet construction. Currently, the wiring process is carried out manually. The development of this collaborative robot to support the wiring process is being driven by a shortage of skilled workers and pricing pressures in high-wage countries. The wiring process is complex and the handling of flexible parts, such as cables and wires, poses many technical challenges. Therefore, humans remain necessary because of their unique skills, dexterity and experience.

The development of the collaborative robot system is the starting point of our research interest. We take it as an opportunity to think meaningfully about how a socio-technical assistance system must be designed under the consideration of being conducive to learning. In this research, we face various negotiation spaces: For example, the development of the social-technical assistance system must consider the managers' and engineers' expectations, algorithmic task allocation to human workers and/or robots, and the workers' autonomy. Further, we continuously reflect upon our own negotiation spaces between social sciences and engineering in our project.

First question: How to translate and materialize a social scientist's perspective into a robot system's design.

The following criteria (Elsholz 2019) are our foundation for developing our socio-technical assistance system:

1. Completeness of the plot and wholeness
2. Scope of action
3. Problem and complexity experience
4. Social support / collectivity
5. Individual development
6. Professional development
7. Reflexivity

For example, *social support and collectivity* and *completeness of the plot and wholeness* are considered in the human-robot interface by providing feedback functionality and visualizing information about the complete context of a task. *Professional development*, *problem and complexity experience,* and *scope of action* are incorporated into the knowledge-based digital engineering approach (Perzylo et al. 2020) that is used by the collaborative robot to formally represent the assembly procedure. Within the resulting knowledge graph we consider both skills of robots and human competencies to assign tasks within the so-called mixed-skill zone (Huchler et al. 2021). This allows on the one hand to provide the human with decision-making autonomy, but can also be used by a decision algorithm to allocate tasks to the human based on criteria related to *problem and complexity experience*.

Second Question: How to negotiate Social Sciences and Engineering

In our project, we have identified various obstacles that lead to misunderstandings on both sides: social sciences as well as engineering. For instance, the involvement of social sciences in an engineering process increased the complexity of developing a technical artefact. Hence, we would like to talk about the following questions in this workshop: How can a mutual understanding of both disciplines be achieved without neglecting their individual motives and foundations?

References

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