

Design of an intelligent workplace system for Human-Machine-Interaction in the digitised industry

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Abstract

Modern industry workplaces include operators working intensely using computers, robots and autonomously operating machines. Tasks including Human-Machine Interaction (HMI) are increasingly integrated into the work process. The work ranges of robots and operators in manual assembly and maintenance are progressively fusing – the coexistence will move towards Human-Robot Collaboration (HRC). Consequently, the higher dynamics of processes in the digitised industry include additional stress factors and offer new challenges: HMI can result in cognitive overload of the worker due to the interpretation of multiple signals and therefore lead to a high risk of exhaustion. Furthermore, there are strong barriers to working with a robot colleague. To increase the acceptance of HRC and to reduce the strain of the worker, user-centered needs have to be sufficiently considered. However, workplaces for HMI are widely developed from a technology-centric perspective. The design research will close this gap by developing a novel holistic method for the design of industrial workplaces. Accordingly, the study places great emphasis on understanding of Human Factors in terms of its physical, cognitive and organizational limitations and their applications to industrial design. The workbench system includes a novel interface directing working tasks to the worker within the networked plant. Derived from the existing Pick-by-Light framework – where operators are directed to particular stock areas via light signals – the approach, named Work-by-Light, utilizes light displays to support the operators solving particular working tasks in collaboration with a robot. In particular, areas of interaction, like the supply and removal of work pieces through the robot, are highlighted as well as instructions for the assembly are communicated (figure 1). Light signals inside the surface of the table are reduced to the minimum of information to support the rapid processing of the instruction through the worker. Consequently, the intuitive utilization of the interface reduces strain in HRC. It will be exemplified how the system can support the worker during maintenance and manufacturing of airplanes. Therefore, explorative testing of a conceptual prototype by potential users is planned.

Key words: Work-by-Light, Human-Machine Interaction, Human-Robot Interaction, intelligent workspace design, digitised industry, aerospace

Image



Figure 1: The Work-by-Light framework supports the worker during maintenance and manufacturing within collaboration of a robot.

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Biography

Johanna Ender passed with distinction her graduation as a Diplom Designer (FH) for product design in 2017 at the Hochschule Wismar, University of Applied Sciences: Technology, Business and Design. She received the Gottlob-Frege-Price 2017 for her final thesis, which was developed in cooperation with the Fraunhofer IGP, Rostock. A study project about a robot integration into a kitchen furniture was awarded with the Anja-Schaible Price 2017 at the Living Kitchen, Cologne. She spend a pre-study practical in Tasmania. While studying, she developed a patent for a household appliance (DE 102015210996A1) for the Corporate Brand Siemens/ Design of the BSH Hausgeräte GmbH within an internship. For her work as a designer, she was awarded as German Design Award Nominee 2018. She has started her international and interdisciplinary PhD research in June 2017 at the LJMU - Faculty of Engineering and Technology in cooperation with the Hochschule Wismar.

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