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SozioTex-Sociotechnical systems in the Textile Industry: Interdisciplinary Competence Build-up in Human-machine Interaction Facing Demographic Change

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Abstract

High-wage countries are on the brink of change, due to social and technological effects. In this paper, we will first Give an outlook on both these effects concerning the German textile industry. Second, we will shortly describe the Interdisciplinary build-up of our research group which influences the way how we address our research issues.

Finally, we will outline two prototypical applications that serve as demonstrators for further user tests and Subsequent developments.

Introduction

The textile industry is the second largest consumer goods sector in Germany, with a focus on technical textiles. Industrial textile machines are used in the manufacture of various products e.g., clothing, lightweight construction, car interiors, or the Field of medical technology. Germany's textile industry - as prominent example forwestern high-wage industries - is on the brink of change, due to both inherently social and technological effects. In this paper, we will firstlygive an outlook on both these effects (cf. 2+3). Second, we will shortly Describe the interdisciplinary build-up of our research group which influences the way how we address our research issues (cf. 4). Finally, we will outline two prototypical Augmented reality (AR)-based Applications (apps) that serve as early demonstrators for further user tests and subsequent developments (cf. 5).

Social Change: Increasing Workforce Diversity

Concerning social reasons, a central aspect has to be seen in demographic changes: He current German workforce is increasingly aging, with a strong increase of employees aged 50 years and older. E.g., according to statistics of the German Federal Employment Agency from 2013, the number of employees older than 60 years increased from 2011 to 2012 by 12.5%. When compared to 2007, this Share of personnel aged 60+ years even increased by 76.9% to a total of1.654.831 people [1]. Overall, further incensement of this age group is prospected. Rather more, the currently high influx of migrants to Germany will soon lead to a more diverse workforce in terms of sociocultural and educational backgrounds. Hence, these demographic Changes will have a massive impact in the German textile industry, too.

Technological Change: Human-Machine Interaction

At the same time, new production technologies based on Cyber Physical Production Systems (CPPS) and the Internet of things (IoT) are pushing their way onto the textile industry's shop floor [2-4], forming the basis for what has been labeled the Fourth Industrial Revolution ('Industry 4.0') by German government and enterprises alike [5]. Due to interaction with smart production machines together with progressive automation, overall industrial processes, work structures, and tasks of employees are changing on all organizational levels. Work tasks and job profiles are becoming more complex. His holds true for the textile industry as well: Individual processes in the textile industry like weaving or finishing are highly automated-- especially in the field of technical textiles. Herefore, the handling of modern textile machines is more complex than before and requires increasing skills of the employees in operation and maintenance. For instance, the requirements of mechanics become more mechatronicsoriented and industrial electricians work more and more together with computer scientists. As a consequence, more and entirely new skills will be needed for ancient and effective human-machine interaction in the near future ('HMI 4.0'). It can be assumed that classic technicians will primarily have to do creative 'trouble shooting' in the future and will therefore take on traits of knowledge workers [6,7]. He combination of both effects, i.e., increasing diversity of the workforce in the textile industry and increasing complexity of smart machines, creates the necessity of human-centered assistance systems that help the individual employee to improve his or her skills and to pass on knowledge to co-workers and colleagues.

SozioTex Research Group Competence build-up in human-machine interaction for the textile industry

Here has been very limited research on the combined social and technological effects on the workplace in the textile industry. Herefore, the interdisciplinary SozioTex team comprising engineers, sociologists, and educational scientists takes on the task of analyzing and evaluating the effects of increasing diversity as well as the increasing usage of highly complex Industries 4.0-technology in the textile industry (Figure 1). Additionally, the SozioTex team designs, tests, and evaluates assistance systems that help cope with the aforementioned effects and minimize the discrepancies between young digital natives and older employees: He former adopt easily to new technologies but open lack professional experience, whereas the latter ones have more hands-on experience but have difficulties when facing working with new digital systems (Figure 1).

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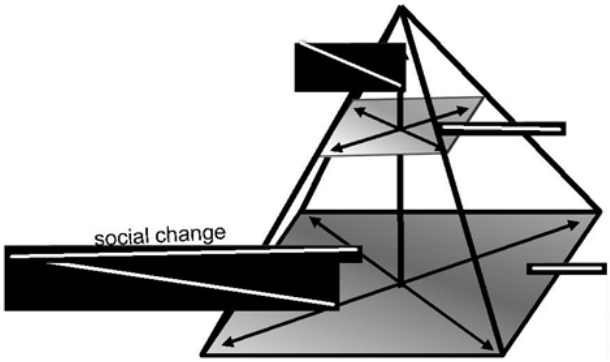

Figure 1.

Prototypical Applications

Augmented reality-based human-machine interaction assistance

So far, the SozioTex team has designed two assistance systems [8, 9]: He first one is based on the assumption that a suitable HMI 4.0 system forms a key element to integrate the flexibility of humans and their ability to handle complex tasks in a textile production unit. Herefore, and HMI 4.0 prototype is developed which serves to support human operators in a (momentarily lab-scale) production unit. He central component consists of smart glasses which serve as the user interface. He see-through wearable device augments the shop floor reality with assistive information. Besides consuming information, shopfloor personnel are also enabled to give feedback to the production unit. Hus, a bidirectional communication channel between the human operator and the Smart Textile Factory is created [9-11]. He second assistance system is a mobile application for smart phones, tablets or smart glasses that makes use of augmented reality (AR) to assist the operator of a weaving machine. He AR application assists in the handling of wei yarn breakages by detecting where the breakage occurred and interactively showing how new yarn has to be inserted [9, 11]. Furthermore, an important part of the SozioTex research draws on an algorithm that enables a method for multi-objective selfoptimization of the weaving process: His system is capable of calculating the optimal parameter settings with regard to user-defined preferences of objective functions. He self-optimization algorithm helps operators to set up a weaving machine with significant On reduced trial and error runs and changeover costs [12, 13].

Conclusion and Outlook

To conclude, the adoption of such Industry 4.0 solutions in the textile industry and its effects on employees are assessed in cooperation with partners in industry and research and along with key user tests of demonstrator models. Furthermore, the compatibility of enterprises to processes is tested and recommended actions are deduced from best practice examples. Herefore, to sum up: the implementation of Industry 4.0-related technologies and systems will only prove successful if the employees are included in the process from the very beginning, as they have to be recognized as the ones who will integrate and use the systems

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