Chapter 6
Assistive Systems for the Workplace:
Towards Context-Aware Assistance

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ABSTRACT

Recent advances in motion recognition allow the development of Context-Aware Assistive Systems (CAAS) for industrial workplaces that go far beyond the state of the art: they can capture a user's movement in real-time and provide adequate feedback. Thus, CAAS can address important questions, like Which part is assembled next? Where do I fasten it? Did an error occur? Did I process the part in time? These new CAAS can also make use of projectors to display the feedback within the corresponding area on the workspace (in-situ). Furthermore, the real-time analysis of work processes allows the implementation of motivating elements (gamification) into the repetitive work routines that are common in manual production. In this chapter, the authors first describe the relevant backgrounds from industry, computer science, and psychology. They then briefly introduce a precedent implementation of CAAS and its inherent problems. The authors then provide a generic model of CAAS and finally present a revised and improved implementation.

INTRODUCTION

Assistive technology has always applied new developments to better support and empower humans. In the form of route guidance systems, context-aware assistive systems (CAAS) have become ubiquitous in cars and smartphones. In work environments, however, context-aware assistance focusing on the worker remained unexplored for a long time. While the quality gates in modern production lines successfully remove failed products from the workflow, they usually

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operate in a spatial and temporal distance from the workplace and the worker. Thus workers have to rely on their skills and their expertise to make the right choices and the right movements. They lack the opportunity to learn from problems on the fly by real-time feedback.

Impaired workers often cannot cope with these high demands – or this low level of assistance. As a result they are assigned comparatively simple tasks or they are removed from the production process completely. Thus both the impaired workers and the organizations providing sheltered work or supported work would profit from a feedback system that operates closer to the worker. In fact these organizations are eager to establish systems empowering their employees to meet the rising customer demands and thus become more profitable (Kronberg, 2013).

A second area where CAAS can be used are "regular" companies facing aging employees. Due to demographic change the percentage of employees aged 60 and above is rapidly growing. Especially in the more developed regions, the ratio is increasing at 1.0% per year before 2050 (United Nations, Department of Economic and Social Affairs, Population Division, 2013). CAAS in production environments potentially improve learning, increase productivity and even enhance the motivation of elderly and impaired workers.

BACKGROUND

CAAS combine elements from different contexts and disciplines:

- Projection and motion recognition clearly are means to realize implicit interaction with computers and thus belong to the computer science.
- Assembly tables belong to the domain of production where computerization follows different rules.
- The integration of motivating elements (gamification) combines psychology with computer science.

Each of these contexts is briefly introduced to illustrate in which aspects the CAAS approach differs from existing solutions and traditions. Also the target users (elderly and impaired persons) are described in this sub-chapter.

Industrial Production

In spite of increasing automation there still are many assembly workplaces the industry. Due to increased product variation resulting in smaller lot sizes (Kluge, 2011) their number even grows in spite of technical advances like semi-autonomous robots.

A workplace for manual assembly usually is a table with attached tools which can be pulled into the workplace area when needed. The parts required for the assembly task are placed in small boxes at the back of the table (see Figure 1).

During the assembly the worker needs to pick the right part or parts and use the right tool to complete a single working step. Often the box to pick from is highlighted ("pick-by-light") and the pick is controlled by light barriers. While the assembly processes are described in manuals or displayed on a monitor, apart from the picking control the worker's actions do not influence the feedback. An inexperienced or confused worker can easily produce a series of faulted products. To avoid this, impaired workers usually either work with reduced complexity (i.e. simple products, few work steps) or need a supervisor to handle the complexity of more demanding workflows (i.e. complex products with several steps).

While new forms of interaction and assistance are readily adopted in many domains, their transgression into the industrial domain, especially into production environments, has been slow. Today Human Machine Interaction (HMI) still lacks

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