Increasing Productivity for Microtasks: A Benchmark for Improving Assembly Instructions

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Abstract

With the decreasing cost in sensor technology, more and more assembly workplaces are equipped with assistive systems to assist workers during complex work tasks. Many systems are using in-situ projection to provide context-sensitive information that help performing work steps. Such systems split very complex tasks into easy micro-tasks and provide instructions for each micro-task. However, creating meaningful and easily understandable instructions for such micro-tasks is an open challenge that we address in our research. Inspired by task analysis from mechanical engineering, we further split micro-tasks into single actions and analyze the effect of the instructions on each action. To provide a standardized way of measuring the effect of instructions on each action, we propose using benchmark tasks to compare instructions with each other. We believe that presenting instructions for micro tasks is an important topic for improving the overall productivity at augmented workplaces. Further we believe that the expertise we gathered over the last 3 years of research in augmented workplaces will be a valuable addition to the workshop.

Author Keywords

Assistive Systems; Interactive Assembly Instructions; Benchmarking; Improving Productivity

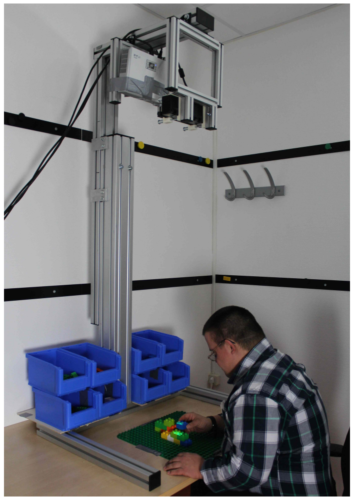

Figure 1: An assistive system supports workers using in-situ projection and detecting micro tasks using a depth camera [1]

Benchmark Instructions for Micro Tasks

As the number of variants for products are increasing and storage cost is expensive, producing a batch of the same product to have them at stock is not feasible anymore. Companies more and more tend to produce ordered products *on-demand*, which leads to an increased cognitive load at the manual assembly workplace. To cognitively support workers at the workplace, assistive systems using in-situ projection have been proposed [1] (see Figure 1). These systems split complex workflows into single micro tasks and provide in-situ instructions for each task. As such systems are designed to continuously provide instructions for the workers, special care has to be taken when designing instructions for assistive systems. Instructions should, (1) be easily understandable, (2) require low cognitive effort to process, (3) require no additional time to handle. To achieve the goal of improving instructions for micro tasks, we proposed using benchmark tasks[1] and splitting the micro tasks into single actions that are analyzed separately [2]. Our proposed General Assembly Task Model (GATM) formula is depicted in Figure 2 and describes the four actions that are required to perform a micro task at a workplace.

$$t_{total} = n\,(t_{locate\_part} + t_{pick} + t_{locate\_pos} + t_{assemble_x})$$

Figure 2: The equation for calculating the assembly time for n microtasks according to the General Assembly Task Model.

The depicted example for splitting complex workflows in small microtasks and single actions is an example how productivity can be analyzed and improved. By combining this analysis with a standardized benchmark task, improving instructions for microtasks is becoming possible to an extent of optimizing on a granularity that is within milliseconds.

[1] Download our benchmark instructions at http://www.hcilab.org/ar-instruction-benchmark/ (last access 01-03-2016)

Further, microtasks can also be easily performed by workers with cognitive impairments. In their work, the authors also investigated which type of in-situ instruction can be used to assist cognitively impaired workers [1] and found that contour-based in-situ instructions are a great possibility to support microtasks that are performed by cognitively impaired workers at the manual assembly workplace [3]. We believe that our experience in creating and evaluating instructions for microtasks using assistive systems will foster discussion and will be a great addition to the workshop.

About the Authors

Markus Funk is a third year Ph.D. student at the University of Stuttgart. His research interests are in Augmented Reality and providing cognitive assistance at workplaces.
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